Aviation Week

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February 27, 1961

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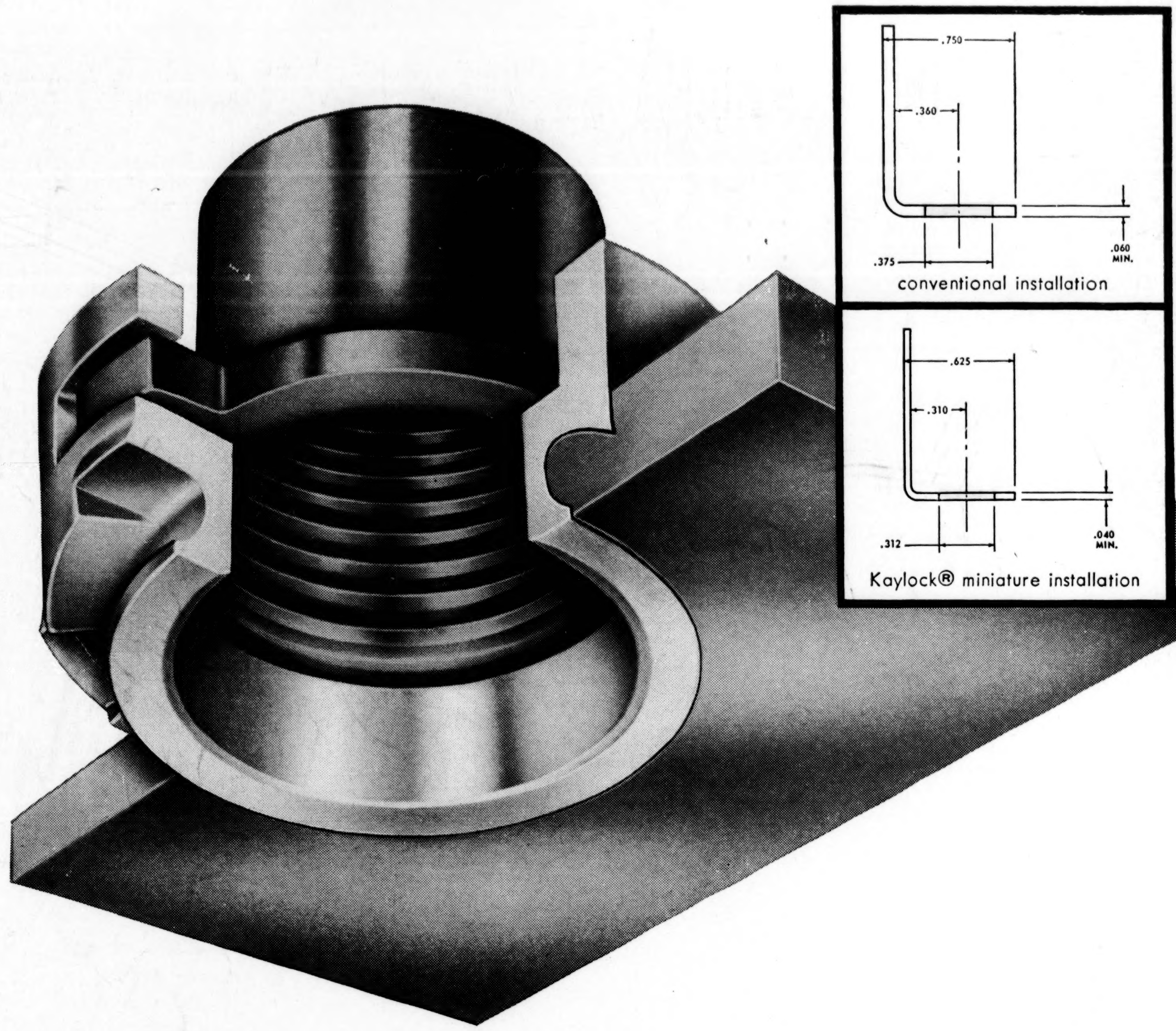

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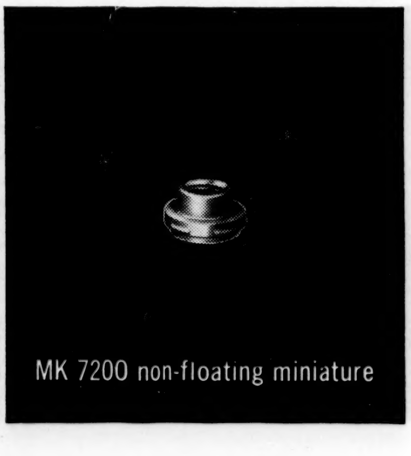
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AVIATION CALENDAR

Feb. 28-Mar. 3—Symposium on Anti-Tank Guided Missile Guidance Techniques, Army Ordnance Missile Command, Redstone Arsenal, Ala.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-16—Missile and Space Vehicle Testing Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation/Space Education, Mayflower Hotel, Washington, D. C.

Mar. 17—Symposium on Interaction of Space Objects With Plasmas Outside the Atmosphere, Sheraton-Park Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 20-24—Western States Regional Convention, Society for Nondestructive Testing, Ambassador Hotel, Los Angeles.

Mar. 23-24—Third Annual Electron Beam Symposium, Alloyd Electronics Corp., Cambridge, Mass.

(*Continued on page 6*)

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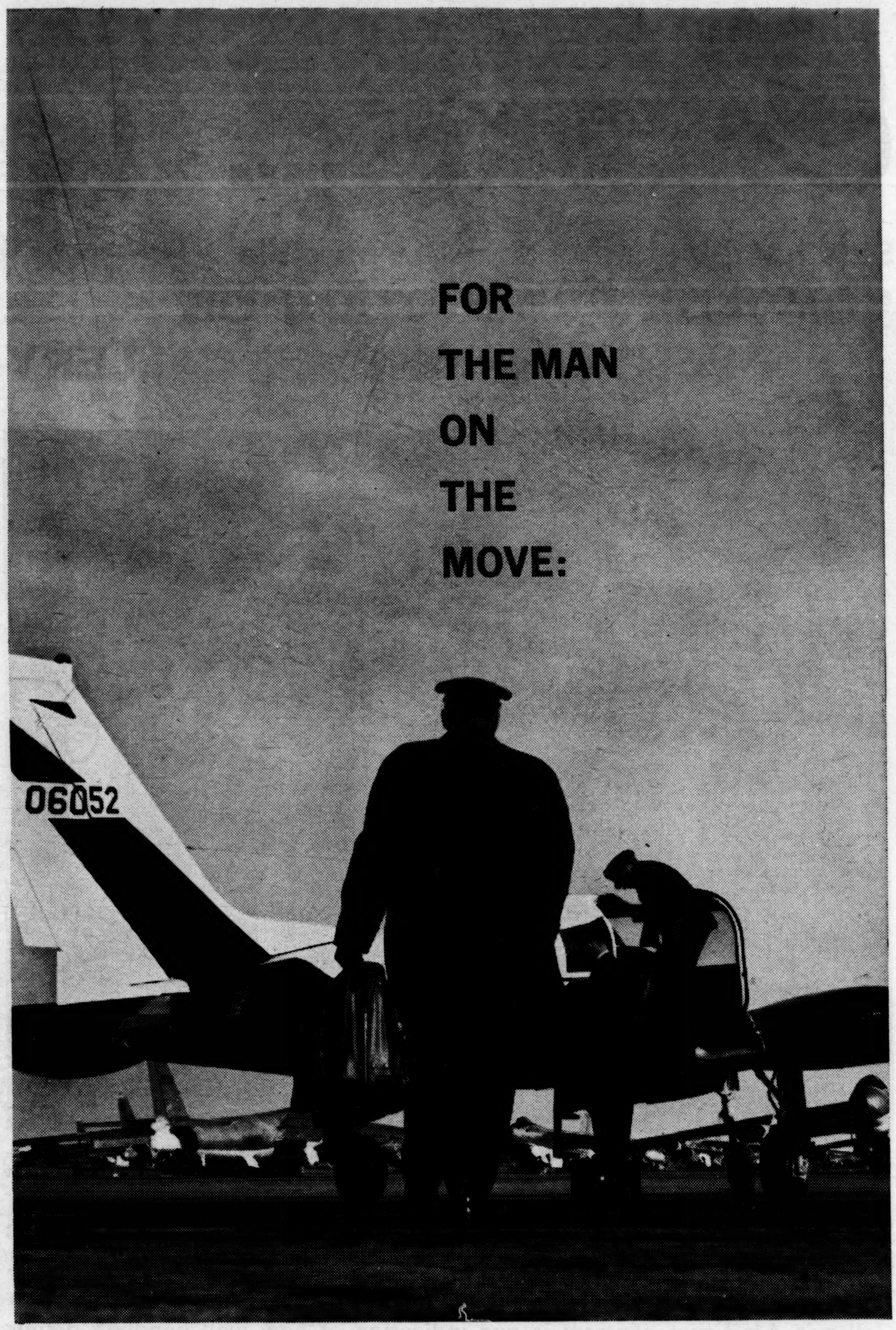

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AVIATION CALENDAR

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Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio.

Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 10-14—International Symposium on Aviation Research and Development, Federal Aviation Agency, Atlantic City.

Apr. 13-14—Annual Meeting, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

Apr. 13-14—Institute of the Aerospace Sciences/Army Aviation Meeting (classified), Washington, D. C.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 22-25—Annual Business Meeting and Conference, American Assn. of Airport Executives, Broadmoor Hotel, Colorado Springs, Colo.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aerospace Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

February 27, 1961

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COVER: Scientist checks experimental version of optical radar during operation over three-mile range near Hughes Aircraft Co. in Culver City, Calif. Pulsed optical maser (small cylindrical device mounted atop the larger telescope receiver) generates a narrow beam of red light as basic radar signal. Reflections from targets are collected by mirror at rear of telescope, filtered, fed to phototube and processed. Wire scatter in front of maser deflects small portion of light output into timing device which sets time reference for radar. In space, device is expected to be capable of distinguishing between tightly clustered targets at great distances. Operational versions may be lightweight—not requiring much power.

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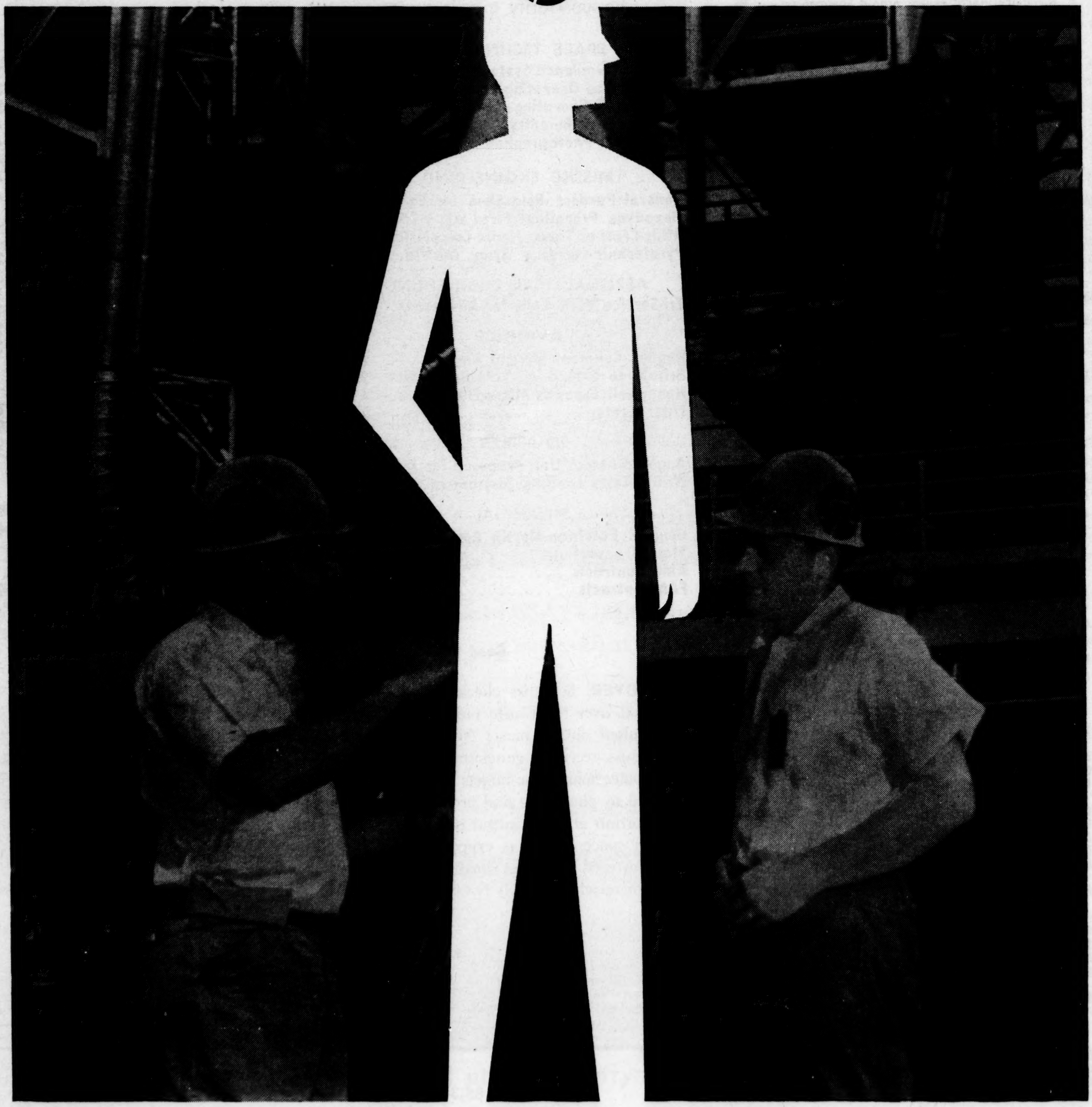


EDITORIAL

Good Luck, Astronauts!

With the designation of three of the seven original Astronauts to make the initial ballistic trajectory flights atop a Redstone missile, the Mercury program has reached a point of no return psychologically if not technically. This selection has pretty well resolved any doubts that may have existed whether Mercury would be pushed to its conclusion of manned orbital flight and makes it crystal-clear that the United States and the Soviet Union are again competing in a significant episode of the fierce technological race that began in the early years of the last decade.

In the Mercury project, the United States is again engaged in a stern chase, with the odds heavily against its winning by recovering the first man alive from orbital space flight. Here again, it is primarily the major disparity in booster power that has relegated the Mercury project to its stern chase of the Soviet Cosmonauts. For it has been the meticulous miniaturization required to cram all of the necessary equipment within the rigid 2,300-lb. weight limit of the Mercury capsule that has caused the longest slippage in the Mercury schedule. This rigid capsule weight limitation was necessitated by the limited booster thrust available from the Atlas—the most powerful booster now ready. With the power from the Soviet boosters that hurled the 10,000-lb. capsules of Sputnik IV, V and VI into orbit available for the U.S. program, it is likely that Mercury could have come close to its original schedule of attempting its first manned capsule orbital flight in November, 1960.

In addition to its technical contributions in opening a vast new area to manned exploration, the competition between the U.S. Astronauts and Soviet Cosmonauts will have enormous impact on international prestige. The progress of these two national efforts to put man into space is being followed with avid interest all around the world, and the prestige harvest for the winner will be great.

Although the prestige aspects of the Mercury program have grown more important since its inception, it has a sound technical foundation and is aimed at valid scientific achievements. It is a genuine pioneering effort in advancing man's capability to explore his environment and not merely a publicity stunt or the delivery of serial rights for a national magazine.

Mercury fits roughly in the middle of a current three-phase U.S. effort to extend the area of manned flight. The first is the joint military-NASA X-15 program, which is scheduled to reach its ultimate performance of 4,000 mph. and 250,000-ft. altitude shortly. This maximum X-15 performance is still less than a quarter of the speed required for orbital flight, and its altitude peak just nudges at the edge of space. Beyond the Mercury goal is the Dyna-Soar program, which although currently only planned and funded through suborbital flight, is aimed at eventually providing manned vehicles that can perform useful missions in orbital flight.

The principal technical goal of Mercury is to determine whether man can survive and function in space flight. The Astronauts will have a variety of functions to perform during their planned triple orbit of earth and 4½ hr. of weightlessness, including changing the attitude of their capsule, making simple navigational calculations and monitoring the automatic phases of their capsule operation. The basic experience from these Mercury flights will provide the foundation on which Dyna-Soar, Apollo and other manned scientific and military space vehicles can build.

There is not sufficiently detailed data available for a comprehensive comparison of the Soviets' Cosmonaut program with Mercury, but some landmarks are visible. The Soviet launchings of five-ton orbital capsules in Sputnik IV, V and VI last year were significant milestones in their Cosmonaut program. The fact that dogs and other forms of life were successfully recovered in one of these three attempts demonstrated the experimental capability of the Soviet system but induced a more sober evaluation of its reliability, even by the Russians. They have been exceedingly cautious in their predictions on manned orbital flight since this experience and have stressed the high level of reliability and safety necessary in an orbital system before it can be entrusted with human passengers.

The nature of the Russians' re-entry success and failures also indicates that they are using a basically different approach to the problem than the relatively simple ballistic re-entry system of Mercury, whose ruggedness was demonstrated so effectively in the recent MA-2 shot with an empty capsule. It appears likely that the Soviets will use a two-man capsule for their manned orbital flights rather than the one-man Mercury type capsule. Again, this is possible because of the greater thrust available from their boosters.

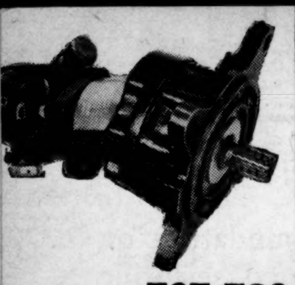
A good "guesstimate" for the first Soviet manned orbital attempts would probably be late spring or early summer. This is based on their proven determination to reap the maximum international prestige harvest from their space achievements by being first, and on the knowledge that it will be mid-summer before the first of the three Astronauts picked for space flight could be ready to make the first attempt at orbital flight, with perhaps early fall as a more realistic date.

The three Astronauts, John Glenn, Virgil "Gus" Grissom and Alan Shepard, are now undergoing the final 60 days of intensive training for the initial space flights in a non-orbital path using the Redstone booster. These preliminary flights, the first test of man and capsule, will probably be made in mid-April, and on their results will depend much of the final scheduling for the crucial orbital attempts.

The aerospace fraternity well understands the hazards involved in man's first attempt at space flight, despite all of the intensive training given the Astronauts and the best technical efforts to make their equipment sound. Since those first December days at Kitty Hawk, test pilots have stood countless times on the same brink of the unknown, willing to risk their lives in an attempt to advance the technology of man's great effort to leave his earth behind. Many have paid the full price of their lives in these attempts, and the possibilities of experimental failure always ride with those with the courage to explore the unknown.

The American people should understand fully the courage and devotion of the seven Astronauts who volunteered for what will probably be the most exciting venture of man in this era. With this understanding, a fervent "good luck" also should go to the three—Glenn, Grissom, Shepard—who have been picked to attempt the initial flights.

—Robert Hotz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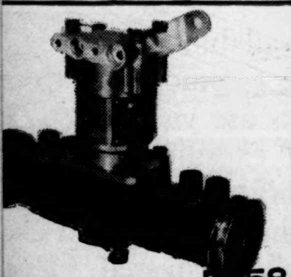
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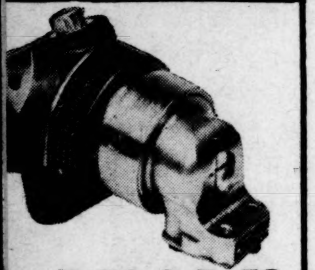
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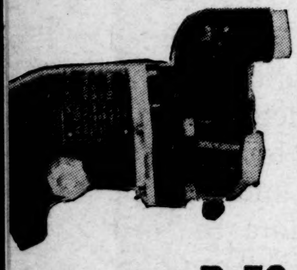
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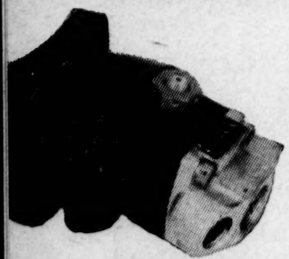
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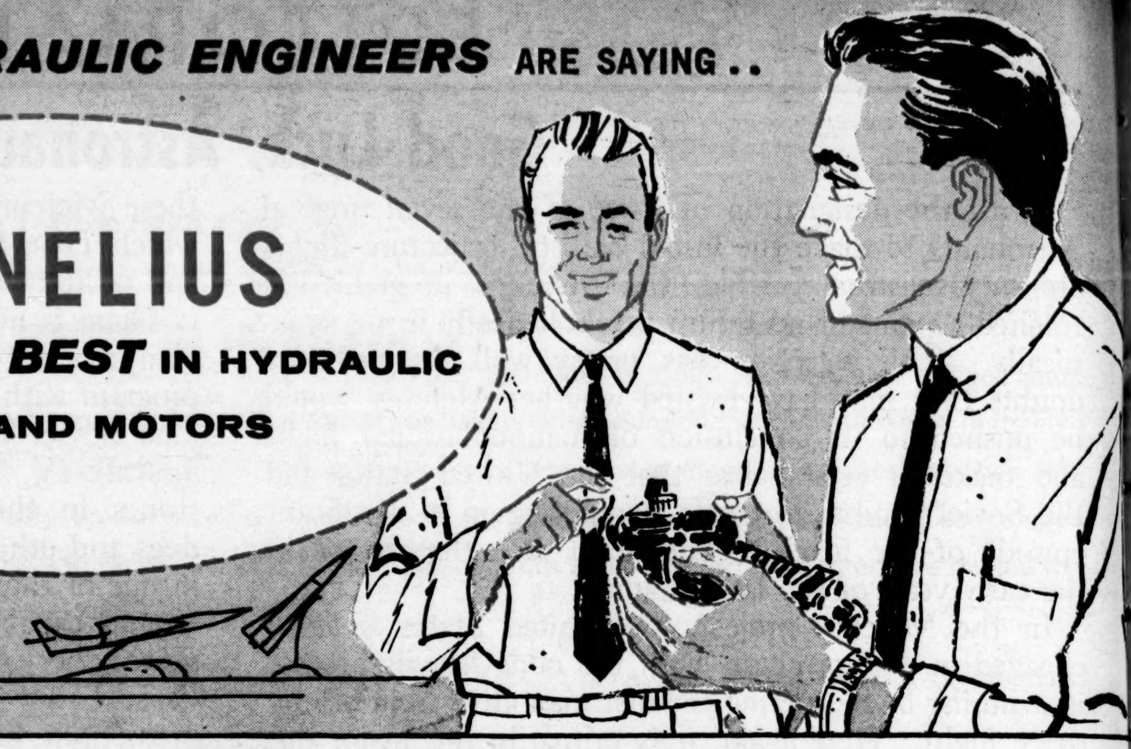

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5	13.3°	.05	23.9	.325	4.55	12000	18000	1.75
6	15.7°	.06	28.6	.390	5.45			
7	18.6°	.07	33.4	.455	6.36			
8	21.4°	.08	38.2	.519	7.26			
9	24.12°	.09	43.0	.584	8.16			
10	27°	.10	47.7	.650	9.10			
11	30°	.11	52.5	.714	9.99			
12	23.5°	.125	60.0	.812	10.2	10800	16000	2.1
16	30°	.160	76.5	1.04	13.1			
20	23.5°	.200	95.5	1.30	14.5	9600	13800	3.0
25	30°	.250	120	1.62	18.1			
32	23.5°	.320	153	2.08	20.2	8400	11900	4.2
40	30°	.400	191	2.60	25.4			
50	23.5°	.500	239	3.25	26.9	7100	10200	6.6
64	30°	.640	306	4.16	34.5			
80	23.5°	.800	382	5.20	37.6	6200	8800	9.0
100	30°	1.000	478	6.50	47.0			
125	23.5°	1.250	600	8.12	53.0	5600	7600	12.0
160	30°	1.600	765	10.40	67.9			
200	23.5°	2.000	955	13.00	75.8	5000	6600	16.3
250	30°	2.500	1200	16.20	94.5			
320	23.5°	3.200	1530	20.80	99.5	4100	5300	23.5
400	30°	4.000	1910	26.00	124.0			

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WHO'S WHERE

In the Front Office

Dr. Jerrold R. Zacharias, nuclear scientist, elected a director of Sprague Electric Co., North Adams, Mass.

O. B. Lloyd, Jr., director of public information, National Aeronautics and Space Administration, Washington, D. C.

Philip M. Stern, Deputy Assistant Secretary of State for public affairs.

Dr. Antonio Ferri, president, General Applied Science Laboratories, Inc., Westbury, N. Y., succeeding **Edward Weitzen**, now executive vice president of Electronic Teaching Laboratories, Washington, D. C. Mr. Weitzen continues as a director of GASL.

Albert E. Blomquist, executive vice president, Icelandic Airlines, Inc., and **Sverre Marcussen**, vice president.

D. C. Arnold, vice president-sales, Alpha Corp., Dallas, Tex., a subsidiary of Collins Radio Co.

L. Wayne Mullane, vice president of the Downey (Calif.) plant of Aerojet-General Corp.

C. Anthony Winser, a vice president, Southern Marine & Aviation Underwriters, Inc., New Orleans, La., with offices in San Francisco, Calif. Also: **William W. Brown**, Pacific Coast manager, with offices in Los Angeles, Calif.

David K. Layser, vice president-finance, Hiller Aircraft Corp., Palo Alto, Calif.

A. L. Lisle, executive vice president and general manager, Control Dynamics Corp., North Hollywood, Calif.

George Q. Mathews, vice president-sales, Rosan, Inc., Newport Beach, Calif., and **Andrew W. Purcell**, project engineer-special projects.

John Manniello, vice president, CBS Laboratories, Stamford, Conn. Mr. Manniello continues as director of marketing.

Erwin Tomash, vice president, Ampex Corp., Redwood City, Calif., and manager of Ampex Computer Products Co., Culver City, Calif. Also: **William N. Mozena**, assistant secretary of Ampex Corp.

Air Chief Marshal Sir Harry Broadhurst, retiring from the RAF, will become managing director of A. V. Roe & Co. Ltd., a member of the Hawker Siddeley Group. Sir Harry succeeds **J. A. R. Kay**, a director of Hawker Siddeley Group, who is now sales director of Hawker Siddeley Aviation, Ltd.

Ellis G. Slack, assistant to the president, Gulton Industries, Inc., Metuchen, N. J.

Raymond H. Heller, assistant vice president, Robertshaw-Fulton Controls Co. Mr. Heller is general manager of the company's Aeronautical and Instrument Division, Anaheim, Calif.

Honors and Elections

Wolfgang E. Moeckel, chief of Electromagnetic Propulsion Branch, NASA Lewis Research Center, **Joseph W. Siry**, chief of Theory and Analysis Staff, NASA Goddard Space Flight Center, and **Knox T. Millsaps**, executive director, USAF Office of Scientific Research and chief scientist, USAF Research Division, have been named recipients of Arthur S. Flemming Awards, annually given to the 10 outstanding young men in government.

(Continued on page 104)

INDUSTRY OBSERVER

▶ NASA's Jet Propulsion Laboratory is expected to ask for proposals before April on the Project Prospector mobile lunar surface vehicle. JPL may choose as many as four bidders for the initial study contracts, which will lead to selection of one development contractor. Companies will have to pay a major portion of the cost of the studies. Industry contribution may run as high as five times the level in the earlier Project Surveyor program.

▶ Boeing is evaluating nine proposals for a Dyna-Soar flight test data acquisition subsystem. The subsystem would convert signals from various sensors monitoring the vehicle's performance into a form suitable for recording or for telemetering through a communications-data link subsystem now being developed by Radio Corp. of America.

▶ Project Surveyor spacecraft will have its Doppler radar-altimeter guidance operating from an altitude of about 2 mi. until it makes its soft landing on the moon. Retrorockets probably will be cut off at 200-300 ft., when three bipropellant vernier rockets will take over to brake the vehicle close to a zero-velocity landing.

▶ Triple-slotted flaps for the Boeing 727 are being tested on the original Boeing 707 prototype. Use of these flaps and of leading edge devices is expected to permit approach speeds as low as 85 kt. for short field operation.

▶ The SS-476L military cargo transport specifications call for the turbofan-powered aircraft to make its first flight within 28 months of contract authorization. First operational transport must be delivered within 38 months.

▶ One Dyna-Soar configuration under study has the retrorocket in the nose, where it would be fired after the jettisoning of a metal nose cap. Separation of the nose cap appears to be a critical consideration.

▶ Radio Corp. of America scientists have sent short-wave length electromagnetic signals about 50-60 mi. under water in tests off the continental shelf as part of their Navy-supported Project Pangloss, a broad study of new communications techniques for Polaris submarines.

▶ Grumman will propose a military transportation version of its Gulfstream transport, powered by two General Electric T-64 turboprops, to Defense Department for tri-service evaluation. Executive version of the Gulfstream has two Rolls-Royce Da.7 Dart turboprops.

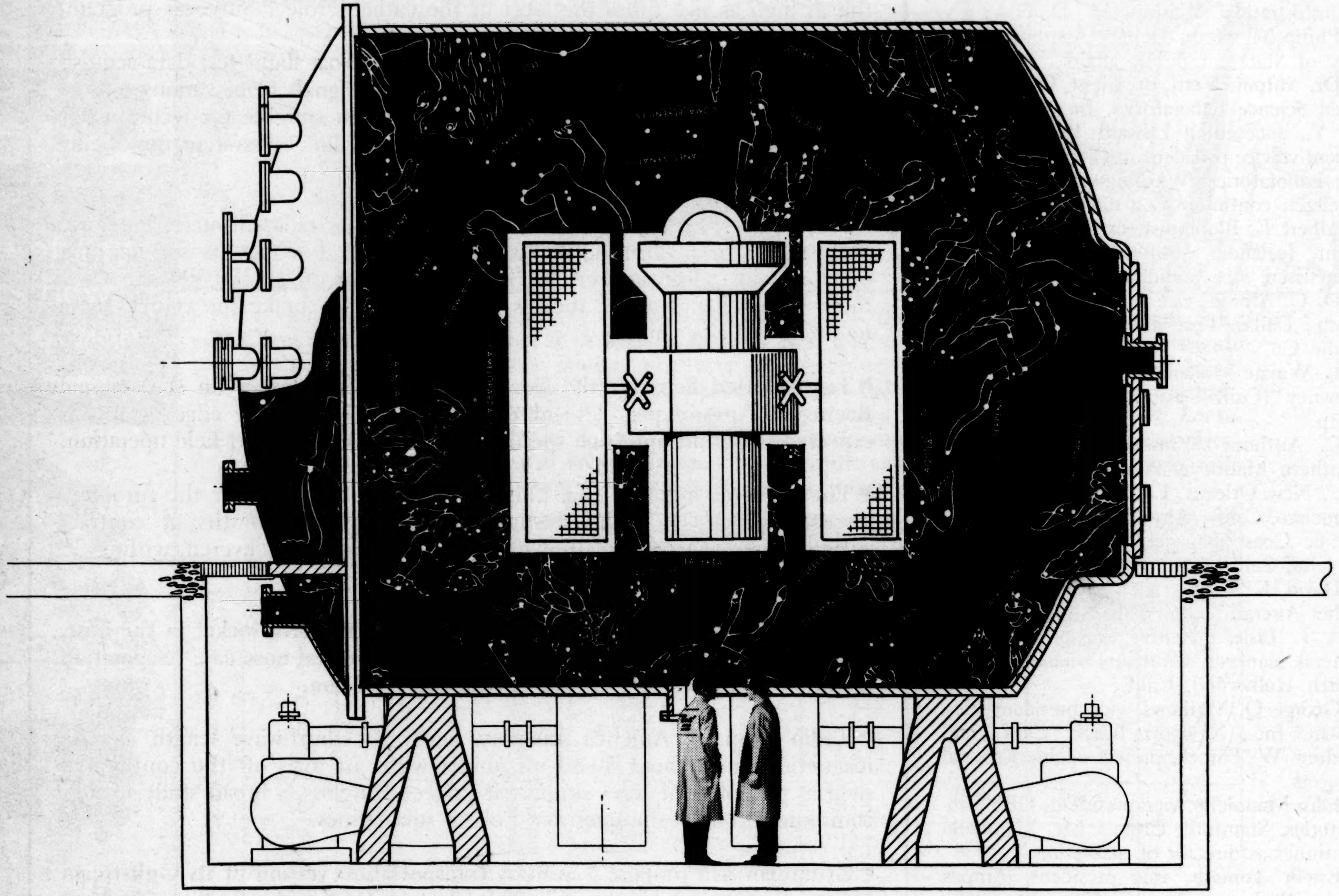
▶ CF-104, Canadian version of the Lockheed F-104G, will carry auxiliary fuel tanks in place of guns in the sides of its fuselage, giving it an added 120 gal. of fuel for its NATO strike and reconnaissance role. Canadair is scheduled to mate wings and fuselage on the first CF-104 soon, and the aircraft is to be airlifted to Edwards AFB, Calif., late next month for engineering flight tests.

▶ Swedish air force plans to equip a new version of its Draken Mach 2 fighter with Hughes Falcon air-to-air missiles and is discussing an agreement with Hughes for license production of the missiles in Sweden. Both radar and infrared versions of the Falcon would be covered by the agreement.

▶ Navy studies indicate it would be cheaper to continue the Lockheed P2V's long production run than to accept proposals that the Grumman Gulfstream or the Fairchild F-27 be used as antisubmarine warfare aircraft.

▶ Turbomeca Astazou II and Bastan IV turboprop engines have received French certification. Bastan IV develops 1,000 shp. and will power the Max Holste Super Broussard. Astazou II develops 554 shp.

▶ COMLOGNET, new transceiver and teletype communications system for ballistic missile logistics, will replace the existing LOGBALNET system in July. COMLOGNET will have the capacity to handle all logistic communications traffic without building a message backlog.



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BENDIX SYSTEMS DIVISION
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THE Bendix CORPORATION

Washington Roundup

Pentagon News Blackout

Watch for an increasing blackout of Defense Department news for policy rather than security reasons. Latest evidence is the drastic restriction of information on Discoverer research satellites. The office of Arthur Sylvester, assistant defense secretary for public affairs, cut the press release material from seven pages on Discoverer XIX to 45 words on Discoverer XXI. No security was involved in the cuts, since most of the material deleted had been contained in earlier Discoverer press releases. First evidence of the Sylvester policy aimed at eliminating participating contractor's names from Pentagon press releases also appeared in the abbreviated Discoverer material.

Increased Navy emphasis on anti-submarine warfare can be expected in view of recently revised estimates that indicate Russia will have 18 missile-carrying subs by 1965. Army will propose its Nike system for anti-missile defense against the seaborne threat.

Soviet Marshal Vasily Sokolovsky said last week that nuclear and rocket equipment of Russia's army and navy put military preparedness at an unprecedented level, and said strategic rocket forces have been established as the principal arm of the armed forces.

Non-government members and staff of the National Aeronautics and Space Council now are expected to be named soon, but legislative complications still are delaying formal takeover of the chairmanship by Vice President Lyndon Johnson. The law now requires the President to head the council.

Subcommittee on Central Intelligence Agency and National Security Agency under Rep. Paul Kilday has been created by the House Armed Services Committee, partly to forestall a House move to establish a separate committee on intelligence. House Rules Committee will continue hearings this week on other proposed intelligence committees.

Rover Review

Four-day review of the Rover nuclear rocket project, due to begin today before the House space committee, will involve National Aeronautics and Space Administration and Atomic Energy Commission witnesses. Industry may not be called until after NASA has evaluated bids—due Apr. 3—on development of Nerva, first flyable Rover engine.

Five days of hearings on the national booster program will be held by the same committee, beginning Mar. 7. On Mar. 14, it will begin authorization hearings on NASA's budget requests.

Joint Congressional Atomic Energy Committee will hold closed hearings on nuclear space projects in mid-March. Committee members already are urging faster work on nuclear ramjets and development of much larger—1 to 10 megawatt—satellite nuclear power units.

Electrical industry's price-fixing troubles are making Congress skeptical of advertised competitive bids on military contracts, until now favored over negotiated contracting. Senate Judiciary Committee is giving Justice Department for review a list of all bids submitted to Defense Department from Jan. 1, 1958 to last June 30 on prime contracts let by advertised bid. Rep. Wright Patman has introduced a bill to require all federal agencies to report identical bids.

House Armed Services Investigating Subcommittee, again headed by Rep. Edward Hebert, will consider, at its organizational meeting—probably this week—whether to hold public hearings on General Accounting Office's charge of over-pricing by McDonnell Aircraft Corp.

Sanger Space Views

Dr. Eugen Sanger, who with his wife Dr. Irene Bredt first proposed boost-glide aircraft, sees some similar type of aerospace vehicle as the answer for nations on the crowded European continent who want to engage in spaceflight. European countries cannot afford the waste or danger of large boosters.

Sanger, in this country from West Germany for a six-week tour of missile and space facilities as a guest of the State Department, believes the British Blue Streak rocket offered to the proposed European "space club" should use specially designed upper stages rather than the British Black Knight or the French Veronique rocket. He said Germany also would like the use of Australia's Woomera range for a variety of projects. So far, Britain has offered use of the range only as a part of the Blue Streak deal.

Dr. Eugene G. Fubini, vice president of Airborne Instruments Laboratory, will take the new post of Director of Applied Research in the Office of Defense Research and Engineering. He holds a Presidential Certificate of Merit for radar and countermeasures work in World War II.

USAF recently changed the name of its proposed satellite interceptor to Hawkeye because some religious groups objected to the previous name, Saint. But Air Force decided Hawkeye connoted snooping and spying, so Saint is now called Saint again.

—Washington Staff

Global Surveillance System Study Planned

Concept calls for manned, maneuverable satellites for reconnaissance. Industry proposals requested.

Los Angeles—Air Force has asked industry to bid on studies of a global surveillance system that could lead to a series of manned, maneuverable satellites in orbit by 1966 or earlier, providing a major advance over the current Samos reconnaissance satellite concept.

The system calls for a series of short-lived satellites that could swoop down from 300 mi. polar orbits to altitudes below 100 mi. for detailed reconnaissance with optical, television and radar devices. Configuration has not been specified, but the satellites might carry as many as three men. Time in orbit for one satellite probably would be about three days.

Although the projected timetable indicates that such a system could be operational by 1966, USAF believes development time could be cut in half, since the program is to rely primarily on existing techniques and hardware. A number of industry observers feel, however, that the timetable is extremely optimistic.

Study programs and associated initial development expected to result from the proposals, which are now being prepared by industry, might cost $15 million to $20 million. There is a strong possibility that some special hardware will have to be developed even to complete these early phases. The proposed system currently is designated Study Requirement 178.

The Samos system will depend initially on a fixed orbit and transmission of its reconnaissance information from that orbit. Later, recoverable capsules will return the information to earth.

The global surveillance system could use photographic techniques to provide a permanent record of objects on earth. These could be analyzed quickly aboard the satellite and studied in detail after its return to earth.

Television cameras, which would produce pictures of lower quality definition than photographic cameras, could be turned on at will by the satellite crew for selective scanning and for transmission to ground stations. Immediate return of this information could be used to alert specific defensive systems to emergency situations. When atmospheric conditions made reconnaissance by photographic and television cameras difficult, radar could be used.

Manned Space Flight Effort

SR-178 highlights the great lack of manned space flight programs now under way in the Air Force. With the exception of the X-15 rocket research aircraft, there is only the Dyna-Soar boost glider, and it will be essentially a research vehicle through its initial stages. Most of the practical U. S. effort in the field of manned space flight is confined to National Aeronautics and Space Administration's Mercury program, which is supported by the services.

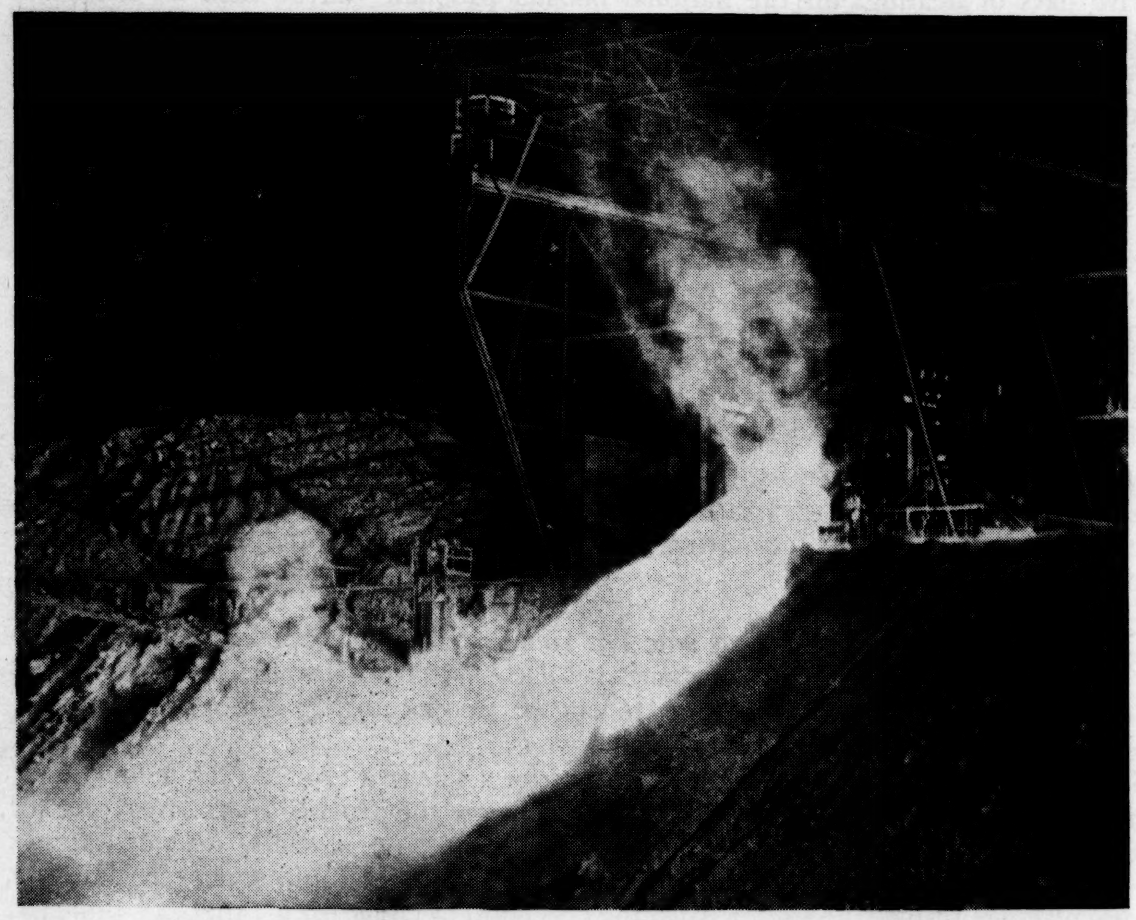
Air Force is allowing bidders wide latitude in almost all aspects of the surveillance system. Unless development were undertaken on a crash basis, even the configuration of the satellite would be able to draw from the experience of Discoverer, Mercury and possibly Dyna-Soar programs.

For an operational system, heavy emphasis would have to be placed on re-entry techniques that would permit a quick letdown into a relatively limited area. The Discoverer program calls for land recovery of re-entry capsules later, and it could be used for development both of hardware and techniques for a system such as SR-178 envisions.

Booster Drain

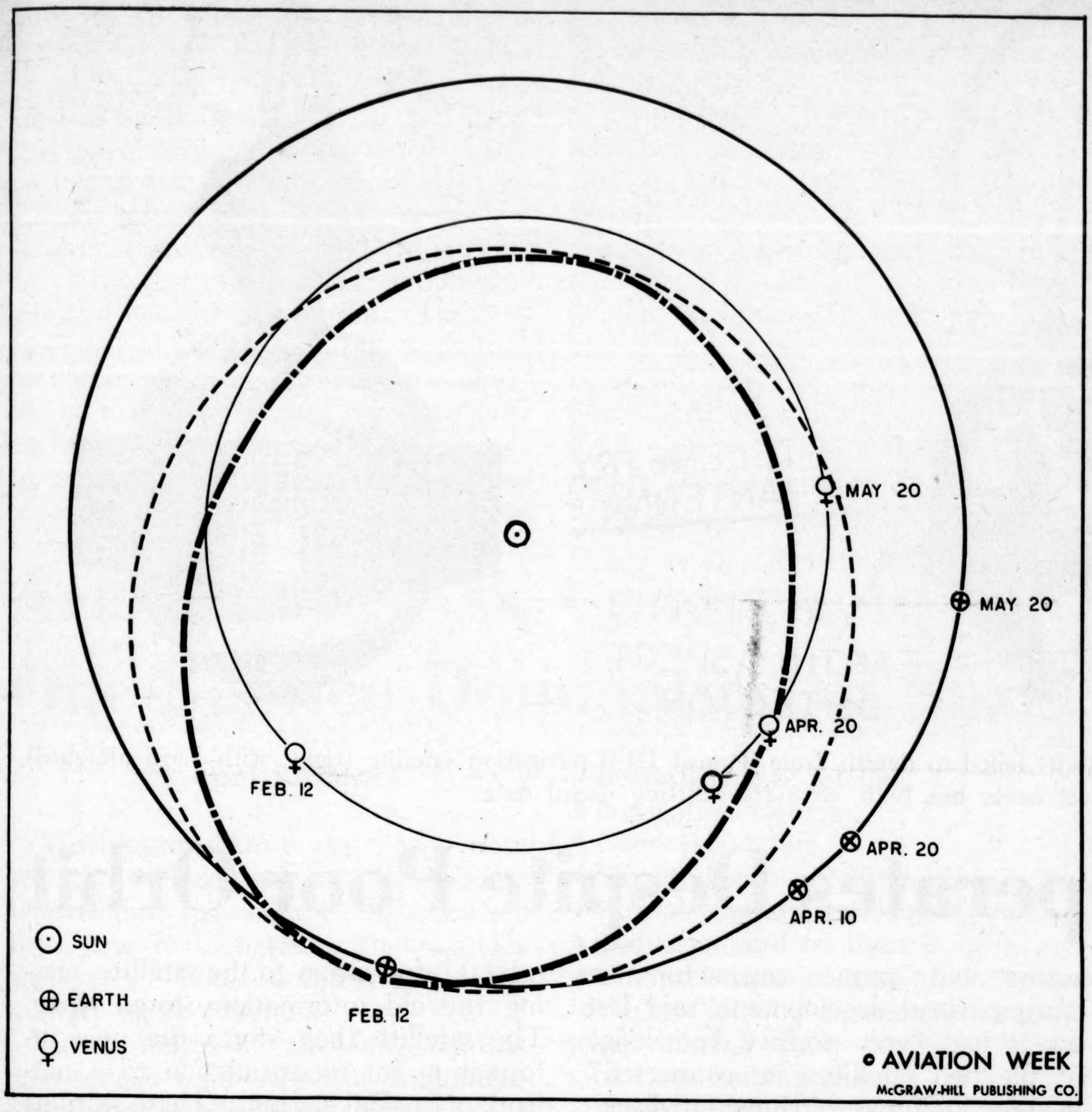
Because of the short time for which weapon planners expect to expose satellite crewmen to the hazardous orbital environment, at least initially, the surveillance system would make a heavy drain on large boosters.

This indicates that booster recovery would have to be considered seriously for such a system to stay within reasonable costs. USAF's Ballistic Missile Division already is giving booster recovery problems close scrutiny because even the early operational Midas and Samos satellite networks will require replacement of any satellite that fails to function properly.



Prototype F-1 Thrust Chamber Fired

Prototype thrust chamber for the Rocketdyne F-1 engine is fired at more than 1-million-lb. of thrust on test stand at Edwards AFB, Calif. F-1 will power large space boosters for National Aeronautics and Space Administration. Chamber was fired at 1.55-million-lb. thrust earlier this month (AW Feb. 20, p. 27) and has been fired more than 100 times at thrusts from 950,000 lb. to 1-million lb. F-1 is the only single chamber engine of this thrust class being developed by the United States. Saturn booster, using cluster of eight Rocketdyne H-1 engines, also develops 1.5-million-lb. thrust. First Saturn flight model is due for test this spring.



PROBABLE TRAJECTORY of the Soviet Venus probe, drawn from data released by the Soviet Union and using Apr. 20 as the date of closest approach. Probe is now in a solar orbit with an aphelion estimated at 93.5 million mi., and a perihelion of 49.8 million mi. Period is expected to be 288 days.

Soviet Probe Operating Normally, To Pass Within 105,000 mi. of Venus

Russian scientists said last week their Venus probe was operating normally and will miss the surface of the planet by no more than 105,000 mi. without midcourse trajectory corrections.

There has been no hint in Soviet reports that the probe can be commanded to change its solar orbital path, although it contains a sensor to detect and evade meteors, the East German Home News Service reported.

Saturn Static Test

Washington—Static firing of the first Saturn flight test booster will begin in the spring following four successful static firings of a Saturn ground test configuration at Marshall Space Flight Center.

Planned test series with the final preflight configuration was stopped after four firings, and NASA said no additional tests are needed because all four were successful. When the program began in December, 6-8 firings were planned. Earlier static tests did not include all eight engines and their associated tanks and systems.

Payload is being commanded to transmit telemetry every five days, and instrumentation is maintaining an optimum cabin environment and measuring the interplanetary environment, the Soviets said.

The Venus probe was launched Feb. 12 (AW Feb. 20, p. 26) and a week later was 1,566,500 mi. from the earth and moving away from the earth and toward Venus at a velocity of 64,164 mph. Cabin temperature was 82-88F, and pressure was 900 mm. of mercury. Late last week, Russia gave British scientists at the Jodrell Bank Observatory near Manchester transmission frequency, but not the times the probe will be commanded to transmit. Jodrell Bank furnishes tracking services to the U.S. under contract.

Extremely cordial comment was stimulated in Russia by the exchange of notes between President Kennedy and Premier Nikita Khrushchev following the probe launching. Soviet press and radio commentary was generous toward the United States, and sees the messages as an opening for "genuine coexistence" and possibly cooperative space ventures.

Japanese press reports praised the Soviet experiment, and the newspaper Mainichi editorially commented that if the United States and USSR "were to consider outer space purely from an academic standpoint, it should be relatively easy for them to cooperate in this field. However, if emphasis is laid on propaganda and military purposes, then such cooperation will be more difficult now that the Soviet Union appears to be considerably ahead of the United States in rocketry . . ."

A. Ilyushin, a mechanical expert, writing in Izvestia, noted that the launching from Sputnik VIII indicates the advancement of Soviet technology because Soviet scientists were able to "cancel or neutralize" mistakes which accumulated between the time of the earth launch and the launch from orbit.

Dandridge M. Cole, of General Electric's Missile and Space Vehicle Department, said that if USSR continues to improve its booster capability at the past rate, it will increase its lead over the United States with an ever-widening gap.

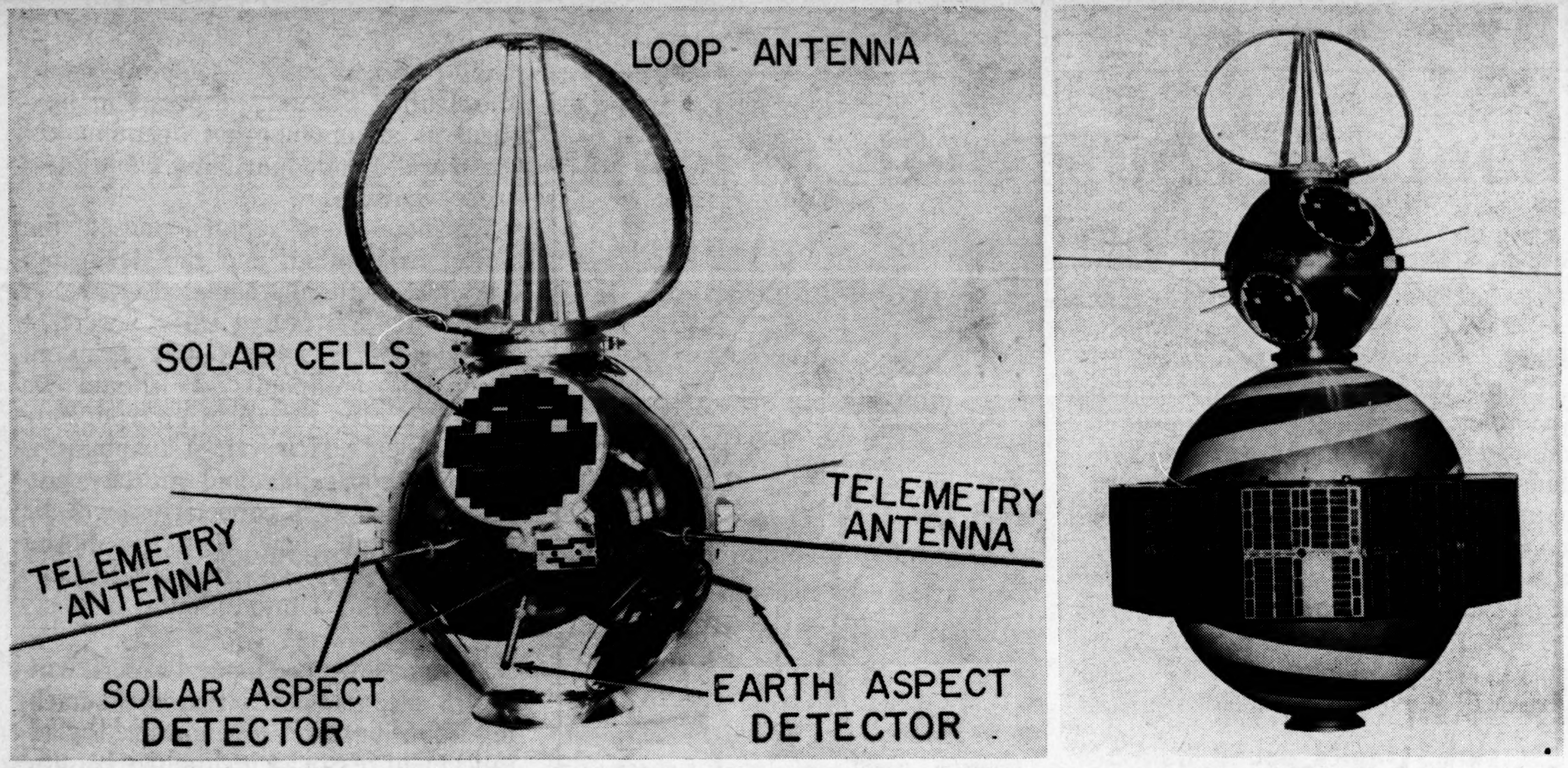
On the basis of past Soviet payload weights, Cole last summer projected potential growth which included the ability to launch a 14,000-lb. Sputnik this year. His projection for mid-1962 is a 30,000-lb. Soviet payload capability, which rises to 100,000 lb. in mid-1964.

Maximum orbital capability of the United States in 1962, with the Centaur launch vehicle, will be an 8,500-lb. payload. Saturn C-1, to become operational in 1964, will have a 20,000-lb. orbital payload capability.

Soviet Surveillance

Moscow—"Considerable prospects" of using satellites as space surveyors of objects on earth are opened by the possibility of using photographic telescopes, N. Varvarov has written in Ekonomicheskaya Gazeta.

In one of the rare Soviet references to anything resembling reconnaissance from satellites, Varvarov said: "The resolving power of conventional aerial photography cameras would make it possible to observe objects down to 500 ft. in size from an altitude of 240 mi. . . . a 240 mm. photo telescope has a resolving power of 1.3 ft. from an altitude of 1,000 mi. This means it is possible to observe objects as small as 1 ft. in size on earth. Photo television and radar, which will make it possible to study the earth's surface and transmit images of it, will also find wide application."



LOFTI low-frequency radio propagation satellite (left) failed to detach from Transit III-B navigation satellite (right, with Lofti attached) when Transit went into a short lifetime orbit last week, but both were transmitting useful data.

Transit III-B Operates Despite Poor Orbit

Washington—Navy's Transit III-B experimental navigation satellite and a piggy-back radio propagation satellite were providing information on all radio frequencies last week in spite of a poor orbit that will cut useful lifetime from the planned three years to perhaps several weeks.

Analysis of radio signals from the experiments aboard and of telemetry data on the solar cell power system indicated that the two satellites may never have separated from the final stage of the launching vehicle nor from each other, as they were supposed to do.

The satellites were launched at 10:45 p.m. EST on Feb. 21 from the Air Force Missile Test Center in Florida by an Air Force Ballistic Missile Division-contractor team. The Douglas Thor-Able Star vehicle was supposed to put them into a 500-naut.-mi. orbit with a 104-min. period and an inclination to the equator of 28.5 deg.

But the Aerojet Able-Star second stage, which has restart capability for refining the orbit, apparently malfunctioned, putting the satellites into an orbit with a 536.1-naut.-mi. apogee and 91.0-naut.-mi. perigee, giving it a period of 96.3 min. Inclination was 28.35 deg.

Navy had hoped that the solar cell-nickel cadmium battery power system would give the Transit satellite a useful life of three years and a life in orbit of some 50 years. The low perigee plus the large frontal area that would result if the satellites and the rocket casing still are connected will permit atmospheric drag to cut the orbital lifetime to a few weeks.

Johns Hopkins University's Applied Physics Laboratory, which is technical director and prime contractor for Transit payload development, said last week it had "very positive knowledge that the two satellites are connected" but only "tenuous circumstantial evidence" that they were still attached to the second stage. The satellites could not have separated from each other until after the Transit payload detached from the rocket stage.

Radio Signals

Radio signals were high and clean but were fading sharply from time to time. Despinning rate of the two satellites was not the proper one, and there were some indications that antenna characteristics were not what they should have been.

Nevertheless, signals from four transmitters in the Transit payload and one in the Naval Research Laboratory's Lofti (Low Frequency Trans-Ionospheric) piggy-back satellite were being received. A 7-lb. Secor (Sequential Collation of Range) transponder, undergoing its first trial in an Army Map Service geodetic experiment, was to be tried later in the week.

The 250-lb., 36-in. spherical Transit payload carried for the first time an experimental magnetic memory system that would be a key part of the all-weather navigation satellite network, which Navy's Bureau of Weapons hopes to have operational by sometime next year.

It also was the first test of a data injection station, operated by the Johns Hopkins laboratory near here. The station stores predicted orbital information, prepared in advance at a computing center. The station transmits new orbital information to the satellite, erasing the old information stored there. The satellite then stores the new information for retransmission to a network of ground stations. These stations monitor the orbit by analyzing Doppler shifts in the satellite's transmission frequencies as it passes overhead, and provide the information to the computing center for the next round of calculations.

Ships and aircraft will be able to fix positions on the basis of signals from an operational network that eventually will include several satellites orbiting at once.

The Transit payload was broadcasting on 54, 162, 216 and 324 mc. The Secor transponder's frequencies were 224, 241 and 448 mc. The Secor unit, developed by Cubic Corp., was to receive and resend signals from four mobile ground stations, three of which were precisely located and one of which was at a less well known geodetic position. Using trilateration with one point in space and the four ground points, the unknown point could be fixed with precision.

The satellites cover a belt ranging from the Tropic of Cancer to the Tropic of Capricorn, and may provide important information on the size and gravitational pull of the equatorial bulge of the earth at the equator and its effect on satellite orbits.

The Lofti experiment, a 57-lb., 20-in. aluminum sphere with six 9-in.-dia. solar cell patches on its surface, was to measure the intensity of very low frequency signals in the ionosphere and exosphere, both those produced by lighting and man-made 18-kc. signals from the 300-kw. NBA Naval Radio Station in the Panama Canal Zone. Naval Research Laboratory trailers were located in Texas, California and Panama to receive telemetry signals from Lofti and ground signals from NBA.

Lofti carried a transmitter, command receiver, five-channel telemetry system, two VLF receivers, a power supply system and two antenna systems. The first consisted of four hinged tube antennas that were to spring out from the equator of the satellite after the nose fairing was ejected. They handled telemetry and ground commands. The second consisted of a rigid, multi-turn loop antenna, feeding one receiver; and a pair of 15-ft. whip antennas which were to extend in flight.

Two other Transits have been launched successfully—Transit I-B on Apr. 13 last year and Transit II-A last June 22.

Although no useful long-term information will be obtained from last week's launch, a Johns Hopkins' spokesman said there is "a very good chance of accomplishing the data injection and readout experiment and verifying the functional design." He said the "partial failure" of the shot would not by itself delay the operational system schedule.

Army, Navy Ask Congress to Halt One-Service Domination of Space

By Ford Eastman

Washington—Army and Navy, both seeking a bigger role in the Defense Department space efforts, have carried their case to Congress with an attack against Air Force domination of the military space program.

Latest moves in the long-standing inter-service feud over the assignment of military roles and missions in space came during a review of research and development activities within the Defense Department before the House Committee on Science and Astronautics.

The most direct attack was launched by Lt. Gen. Arthur G. Trudeau, chief of Army Research and Development. He said space is not to be considered as the exclusive territory for operations of a particular service, but that it is a "most useful and potent new environment" to better support recognized military missions for all services.

"I personally feel that the military use of space is too vital to be entrusted to any one service," Gen. Trudeau said, "but should come within the jurisdiction of centralized military control at the Department of Defense level, separate from the services."

Navy witnesses supported the Army contention that space is an environment rather than representing a role or mission, but they did not urge centralized control of projects, separate from the services. Instead, the Navy maintained that it should be given a greater role in space and listed 10 "main astronautics endeavors that will provide direct and significant improvements to the nation's sea power." They are:

- **Tactical booster** for naval operations, suitable for sea launch of satellites into orbit around the earth.
- **Satellite defense** system which would avail itself of sea-launched rockets.
- **Space surveillance** system.
- **Reconnaissance satellite.**
- **Navigation satellite.**
- **Geodetic satellite.**
- **Meteorological satellite.**
- **Several communications** satellites.
- **Global ground facilities** for space.
- **Comprehensive research** program that includes "looking squarely at the day when manned space operations become vital to national defense."

Rear Adm. Thomas F. Connolly, assistant chief of the Bureau of Naval Weapons, told the committee last week that the Navy has chosen space systems and space technology that do not press too far and too fast into the uncertainties and the unknowns, but rather tries to accomplish what it knows can be done "well and now."

"All the systems the Navy has chosen," he said, "are within the state-of-the-art; none requires new inventions or breakthroughs on which we cannot count. This is not to say that we do not have a sound program of basic research, we do—but our systems and the applications of space technology are attainable and have a high probability of being successful."

Vice Adm. John T. Hayward, deputy chief of naval operations-development, said most of the Navy's proposed endeavors could be accomplished by producing a small, economical vehicle called the Sea Scout. This rocket would use the solid-fueled Polaris as the first two stages with the National Aeronautics and Space Administration's Scout Antares and Altair rockets as the third and fourth stages (see p. 30).

He said that if the Defense Department should approve the Sea Scout proposal, it could be ready within a year to place payloads of 150-200 lb. in a 300-mi. orbit, and it could be launched from either land or sea. Later, when more powerful Polaris missiles are developed, he said, the Sea Scout could be launched from a submerged submarine to place satellites into orbit.

In addition to launching the Navy's proposed satellites, Adm. Hayward said Sea Scout also could be developed into a missile to destroy hostile satellites. Another use, he suggested, would be to help other countries launch payloads into orbit by sailing the launching ship to the country involved.

Lt. Gen. Bernard A. Schriever, commander of the Air Force's Air Research and Development Command, told the committee that development of an unmanned satellite with an automatic detection system and automatic weapon offers the highest promise as a defense against intercontinental ballistic missiles. It is one of more than 250 proposals under study by ARPA in its Defender program.

Presumably the system would employ a technique similar to the one the Russians used in launching their Venus probe—placing a space vehicle in orbit containing a smaller missile that is aimed and fired on command.

As a defense against ICBMs, the satellite would use infrared detectors and its weapon would be aimed and fired at ICBMs shortly after they were launched, which Gen. Schriever cited as a great advantage.

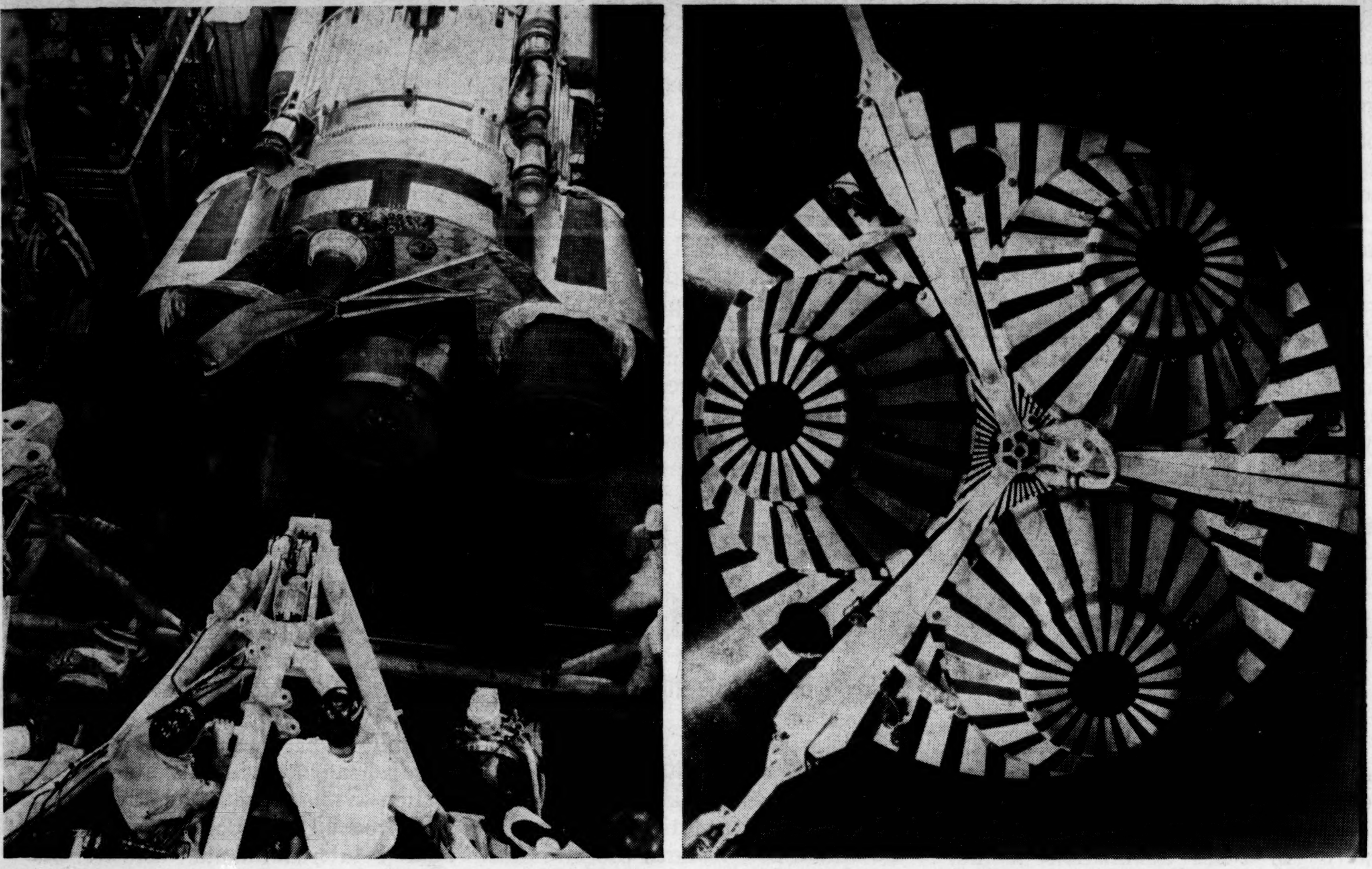
Gen. Trudeau and Richard Morse, nominated last week as assistant Army secretary for Research and Development, strongly urged early, but limited production of the Nike Zeus antiballistic missile system to defend against ICBMs. Nike Zeus represents the ground-based missile approach to anti-ICBM defense.

Nike Zeus is the only system which can be produced and deployed within the next decade, Morse said. Since no potential enemy has the capability of launching a massive nuclear missile attack—in terms of thousands of missiles—or will have it in the near future, Morse added, the threat is small numbers. It is against this type of threat that the Nike Zeus system would be most effective, he said.

He told the committee that communications satellites for military and civilian applications are essentially indistinguishable from each other and that the United States cannot justify more than one national effort in the active communications satellite area.

Airlift Details

Washington—Defense Secretary Robert McNamara gave a further breakdown to Congress last week on recent aircraft orders aimed at increasing airlift capability. He said 99 Lockheed C-130Es will be bought, instead of 50, by reducing C-130B orders to 26. By speeding up production of the B model, USAF will get the first 50 E models by March of 1963, instead of September 1963.



TECHNICIANS calibrate the booster while it is in a horizontal position in pre-launch preparation for the second Mercury-Atlas mission. Striped package (right) houses dummy retrorockets and live separation rockets. Rocket pack is mounted on the capsule heat shield.

Mercury-Atlas Re-entry Test Successful

By Edward H. Kolcum

Washington—Near-perfect trajectory was flown in the second Mercury-Atlas test last week when a production capsule and its systems performed successfully under the high angle re-entry loads imposed by an intentional abort at staging—the most severe set of stresses the capsule should ever have to undergo.

The MA-2 vehicle was launched from the Air Force Missile Test Center on Feb. 21. Upper section of the Convair Atlas booster had been strengthened with two permanent and one interim modifications. Upper end of subsequent Atlas boosters for the Mercury capsule will be made of a heavier gage steel and will be essentially the same airframe used for Air Force Samos and Midas payloads.

MA Performance

Performance of the modified MA system was in marked contrast to that of the MA-1 vehicle, which flew an estimated 65 sec. and then exploded last July 29 (AW Aug. 8, p. 26). Both missions were designed to measure system performance in an abnormally steep re-entry at an angle of 8 to 10 deg. from the orbital path.

The capsule was launched at 9:10 a.m. and impacted 18 min. later, 1,425 mi. downrange. It was sighted by a Navy P2V search plane four minutes after impact and was recovered by a Marine HUS helicopter at 9:53 a.m.

The capsule was deposited on the deck of the landing ship-dock USS Donner at 10:06 a.m.

The Donner was on station only 13 mi. from the impact point. Trajectory precision was the best attained so far in a Mercury test launch, with impact 25 mi. farther downrange than estimated, and the 114-mi. apogee one mile below the estimate.

Peak Velocity

Peak velocity was 12,850 mph., compared with 13,000 mph. estimated, and the 16.5 maximum g-load was 0.5g over the estimate. Peak heating loads were estimated to be normal—3,000F on the ablation shield, and 2,000F on the afterbody. Internal cabin temperature did not rise above 90F during the flight.

MA-2 was the first flight in which the Atlas abort sensing system operated on a closed loop, and also was the first flight for the 16-ft. pylon escape tower aboard the Atlas. Operational systems not flown were the landing impact skirt, environmental control system, pilot couch, control panel and retrorockets, all of which have been tested previously.

The MA-3 trajectory will bring the flight path tangential to the orbital flight path, and will be a complete test of the capsule and its systems during an injection abort, with a normal 1.5 deg. re-entry. Date for launch of MA-3 depends on delivery of the heavier-gaged Atlas boosters, scheduled for early spring.

Mercury-Atlas Schedule

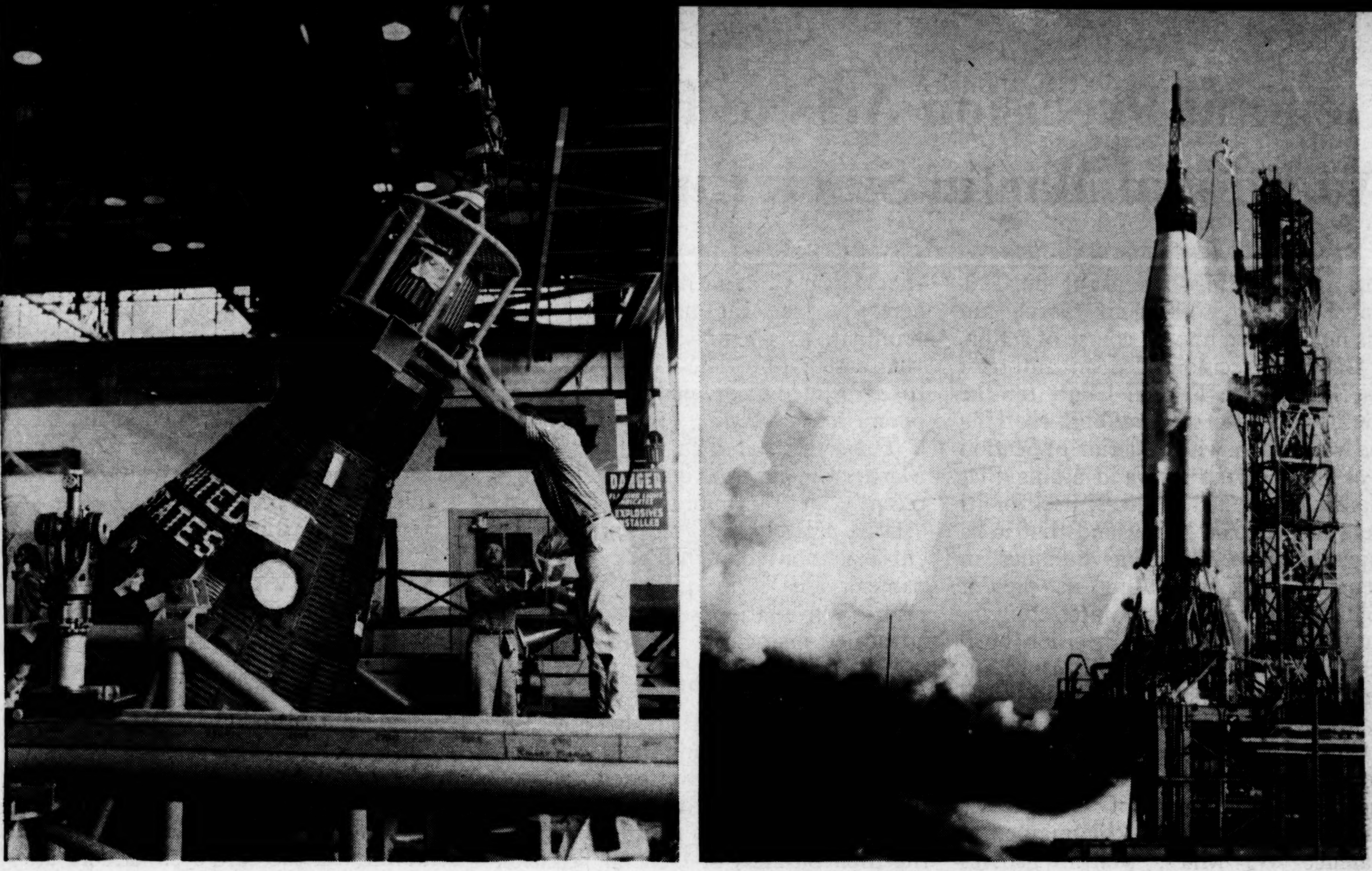
Big Joe, MA-1 and MA-2 test vehicles were launched on 108-deg. azimuths, and the remainder of the MA missions will be launched on azimuths of 73 deg.

Present plan calls for MA-4 to be a repeat of MA-3 with a chimpanzee passenger; MA-5 a three-orbit mission with no passenger; MA-6 a three-orbit mission with a chimp, and MA-7 and MA-8 to be three-orbit manned missions.

Interval between launches is expected to average about a month, and the schedule and missions depend on reaching test objectives of previous launches. A total of 14 MA launches is planned, and if MA-3 through MA-6 are successful, MA-7 through MA-14 could all be manned missions.

Interim change in the booster airframe for the MA-2 launching was installation of an eight-inch stainless steel belly band around the upper part of the Atlas (AW Feb. 6, p. 27).

Permanent changes for MA-2, which



SECOND MERCURY-ATLAS flight was preceded by weight and balance test (left) and static test firing of the booster-capsule configuration at the Atlantic Missile Range. Capsule was subjected to severe heat and air loads in its successful test flight last week.

will augment the heavier Atlas skins for all later MA-boosted vehicles, are:

- **Adapter ring between booster** and capsule has been strengthened; cross members and stringers have been added and strengthened.
- **Bracing has been strengthened** on the elbow-shaped oxygen vent valve on the top of the booster liquid oxygen tank.

Staging Abort

The MA-2 mission duplicated the re-entry dynamics which would occur in an abort triggered during staging—when the Atlas booster section dropped off and the sustainer was still burning.

Flight provided extreme heating, dynamic pressure and g-loads on the capsule, but, most important, it served to verify compatibility of the Atlas and the Mercury capsule. Atlas has had little success in orbital space missions (AW Jan. 23, p. 88), but its use as Mercury booster is strongly backed by the National Aeronautics and Space Administration. NASA feels strengthening the upper airframe will solve the problem, and the MA-2 booster was fitted in the adapter upper airframe section with strain gages, thermocouples, break wires, accelerometers and an extensionometer to verify wind tunnel data.

Flight sequence involved shutting down the sustainer engine just before burnout, which occurred at an altitude of 107 mi. Escape pylon is not used in this type of abort (AW Feb. 13, p. 29) and was jettisoned when the outboard Atlas engines dropped. The capsule was separated by explosively releasing the restraining clamp and igniting three separation rockets.

The capsule coasted to the 114-mi. perigee, oscillations were damped out during the five-second period following separation, and it was oriented in a 34-deg. attitude for retrorocket firing. Sequencer received a signal simulating firing of the dummy retrorockets as a test of the timer used to jettison the rocket package. The timer worked properly, and the package was dropped 90-sec. after the simulated rocket ignition.

Mercury Pilot Pool

Washington—Pool of three Project Mercury pilots has been chosen to train for the initial Redstone-boosted ballistic flights and has been assigned to the Atlantic Missile Range.

Marine Lt. Col. John H. Glenn, Jr., Navy Cdr. Alan B. Shepard, Jr. and Air Force Capt. Virgil I. Grissom are entering the pre-flight training phase for the Redstone missions, which now are expected to start in April. The pilots will undergo intensive training with Redstone mission capsules, and with launch, tracking and recovery crews.

Mercury Director Robert R. Gilruth, who selected the three pilots for Redstone missions, said the choice was based on medical and technical information obtained during the 22-mo. training program.

He also said all seven Mercury pilots are eligible for later Redstone flights and for orbital missions.

Selection of a primary team of three pilots for suborbital Mercury missions was predicted by Aviation Week 14 months ago (AW Dec. 28, 1959).

The capsule then went into a −1.5 deg. pitch-down attitude in relation to its flight path, which resulted in an 8-10 deg. re-entry angle in relation to the earth's surface.

Peak Re-entry Load

Peak re-entry load of 16.5g was described as very brief, and total time above 10g was about 25 sec.

The capsule was in weightless flight 4 min. 45 sec. during its 18-min. flight.

The capsule was one of the earlier versions from the McDonnell Aircraft Corp. production line and did not include an impact skirt. Skirt is on all capsules which will carry passengers to attenuate landing shock and to act as a sea anchor.

NASA expects that because of the precise trajectory, the predicted loads will be verified when data is reduced. Heating load was expected to be 25-30% higher than on a normal orbital re-entry, and re-entry g forces about double those on the normal mission.

Maximum dynamic pressure, or "q," was about 900 lb. psf., three times the normal load.

General Precision Acts to Restrain Additional Martin Stock Purchases

New York—Martin Co. is studying an anti-trust suit filed against it by General Precision Equipment Corp., but has not decided upon a course of action.

General Precision filed an anti-trust suit Feb. 17 in Federal Court for the Southern District of New York charging the Martin Co. with violation of Section 7 of the Clayton Act and asking that Martin be ordered to divest itself of its General Precision shares and that it be enjoined from increasing holdings in General Precision, voting its present holdings or in any way interfering in the conduct of General Precision business. General Precision also asked for damages and other appropriate relief against Martin.

General Precision's legal move was prompted by a letter from Martin requesting appointment of George M. Bunker, Martin board chairman, and Clarence W. Miles, Martin general counsel and director, as Martin representatives on the General Precision board, and asking for removal of six present directors. General Precision's board rejected the request.

James W. Murray, General Precision's board chairman, said Martin "has been buying our stock for about two years. During this period that company has several times publicly announced that such acquisition was simply for investment, thereby implying no ulterior motive. The proposals and demands recently made by the Martin Co. are quite inconsistent with such statements and are evidence of an attempt to destroy the independence of General Precision and to take over control and direction of this corporation for the benefit of the Martin Co.

"In the opinion of the management and board of directors of General Precision, such a result is certainly not in the interest of General Precision shareholders," Murray said.

Letter to Stockholders

A letter mailed by General Precision to company stockholders and signed by Murray and D. W. Smith, president, stated that "Mr. George Bunker, chairman of the Martin Co., had demanded two seats upon the board of directors of General Precision Equipment Corp., one for himself and the other for his general counsel, and the removal of six directors from the General Precision board, including five outside members. The General Precision board currently has 14 members.

"The board of directors of General Precision considered the demand in detail at its meeting on Feb. 14 and found it unacceptable. We so informed the Martin Co. and in turn asked it to agree to take the necessary steps to terminate its attempt to seize control of your corporation. The Martin Co. failed to give such agreement in the time period set."

The letter stated that officers of the Martin Co. have several times, and as recently as the month of February, "stated publicly that they have no present intention to merge the two companies. This is in conflict with their private conversations in which they have advocated merger."

Competition Factor

General Precision holds that any takeover of it by a company such as Martin can only have an adverse effect upon General Precision's business with its competitors, because more than 50% of the total business of General Precision companies is done with competitors of the Martin Co., compared with about 1% with Martin. The largest customers of General Precision, besides the government, are direct competitors of the Martin Co., according to General Precision.

General Precision says Martin holds about 15% of 1,573,516 voting shares outstanding.

In 1960 General Precision earnings were $5,312,692 on sales of $244,427,566, compared with 1959 earnings of $4,198,200 on sales of $215,588,430.

Martin Co. estimates 1960 earnings at about $16 million on sales of approximately $600 million, compared with 1959 earnings of $13.3 million on sales of $523.7 million.

Britain to Extend Aircraft Radar Net

London—Britain has begun work on a new high-performance radar system incorporating computers and data handling equipment. The nation also is considering plans to launch a series of upper-atmosphere research rockets, the Annual Memorandum on Air Estimates disclosed here last week.

New military radar with equipment for detecting supersonic aircraft will have longer range and increased altitude cover, and also will form part of an integrated civil and military air traffic control organization.

Radar will deal only with aircraft, complementing the ballistic early warning station at Fylingdales, Yorkshire, which the Memorandum said was making good progress. Royal Air Force radar already is providing a service for both civil and military aircraft above 25,000 ft., and service will be expanded to cover most of United Kingdom air space.

Meteorological office, run by the Air Ministry, is studying proposals for two continuing series of weather and geophysical research rocket launchings from the United Kingdom, designed to study temperatures, movement and composition of the upper atmosphere.

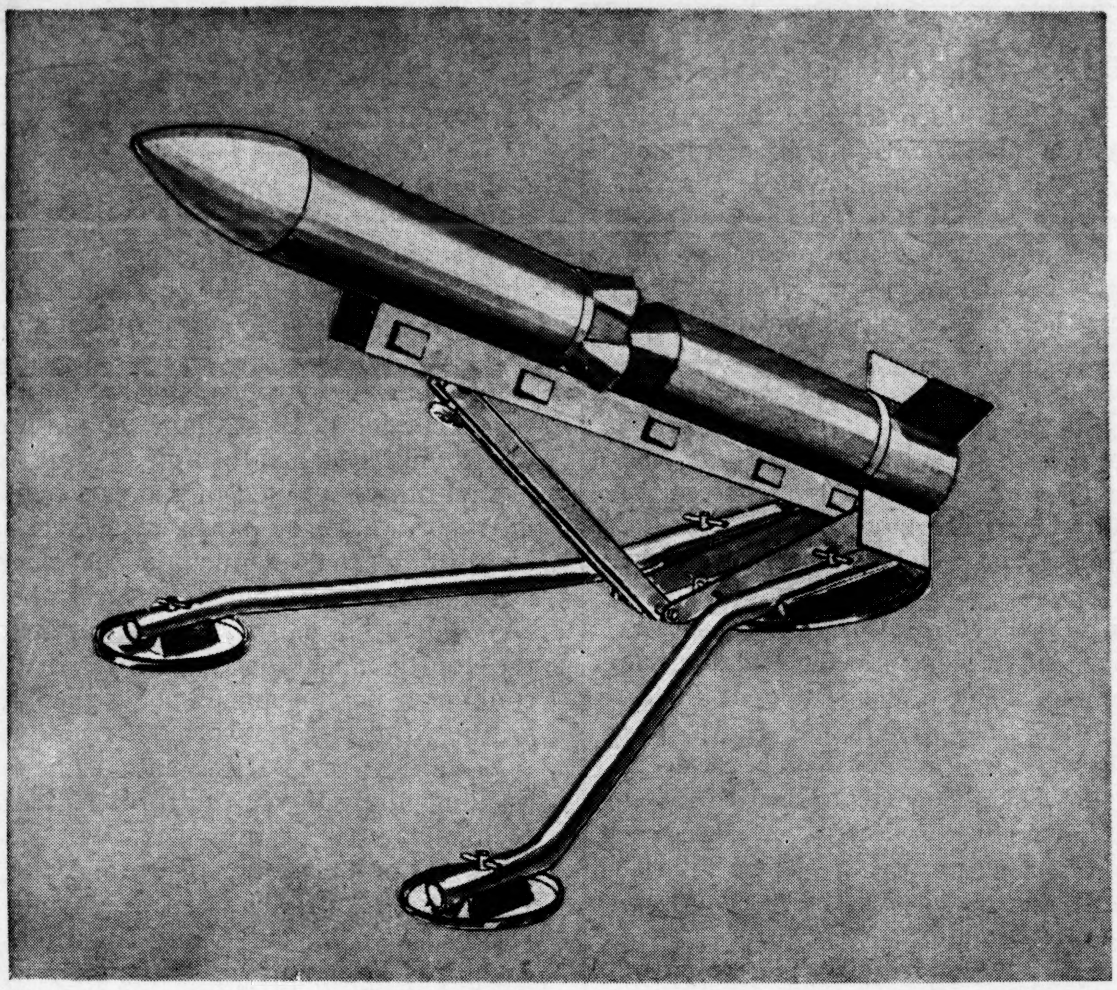
One series, with an altitude of about 37.5 mi., would be launched at the rate of one a week, while the other would be launched perhaps once a year to an altitude of about 62.5 mi.

Other activities outlined by the Memorandum:

- **Vulcan** and Victor MK.2 jet bombers probably will remain the prime strike force of RAF's Bomber Command for the next decade.
- **Handling trials** of the Avro Blue Steel guided standoff bomb will begin this year.
- **Skybolt air-launched** ballistic missiles will be bought outright and fitted to Vulcan Mk. 2s, using British warheads, sometime in the mid-60s. Orders are being placed for the Bristol-Ferranti Bloodhound Mk.2 ground-to-air weapon.
- **British Aircraft Corp.** TSR-2 tactical strike reconnaissance aircraft will go into service in the mid-1960s, probably modified to include a possible strategic capability.
- **Orders have been placed** for the English Electric Lightning Mk.3 supersonic fighter which will carry an improved air-to-air weapon believed to be a development of the de Havilland Firestreak.
- **Transport Command,** which has tripled in size during the past 10 years, will continue its build-up with the additions of 10 Belfast freighters, each able to carry a 35-ton payload, five Comet 4Cs and 56 Armstrong Whitworth Argosies.
- **Helicopter force** will be expanded with the introduction of the twin-rotor Belvedere and the first of 70 turbine-engined Whirlwinds. Twin-engined version of the Westland Wessex also is due to be placed in service.
- **Expansion of Transport Command** and continued reliance on manned bomber force means RAF will need aircrews until 1970 and probably up to 1980, and is presently facing a "crucial" shortage of high-caliber recruits.

The Memorandum emphasized that Britain would continue to rely on its $1.4-billion V-bomber force in line with acceptance of manned aircraft as an effective deterrent.

Over-all spending, the report continued, will be $1,474.8 million in 1961-62. This is a decrease from the $1,499.4 million spent last year, reflecting a reduction in aircraft procurement and stores.



ARMY'S new battlefield illumination missile is designed to tow its pyrotechnic payload. Artist's drawing depicts probable operational configuration of the missile, which is still under development at Picatinny Arsenal.

Pyrotechnic-Carrying Army Missile Is Designed to Tow Its Payload

Dover, N. J.—New Army missile now under development is designed to tow its payload, rather than push it in the conventional manner.

First test flight of the new missile is expected to take place next April. Until then, Army scientists will not know how accurate and efficient this unconventional design concept is. So far, however, the missile has performed well in all static and other tests, says the Army, and has yet to encounter any of the aeroballistic or heat transfer problems at first anticipated for this design.

Solid-Propelled Vehicle

The tow ballistic missile is a small, solid propellant vehicle and will be fired from a zero-length launcher. Designed for battlefield illumination, the missile carries a pyrotechnic package in its tail which is ejected backward at a predetermined altitude and then floats downward on a parachute. Primary reason for putting the motor ahead of the payload was to prevent the missile from shooting down its own payload.

At the same time, however, placing an easily ignitable pyrotechnic package behind a hot-firing rocket engine presented its own ticklish problem. The Army will not say how it solved this particular dilemma, only that static firings show that it is not now a problem. The answer is believed to lie in the combined use of multiple small nozzles canted outward and heavy insulation at the head of the payload canister where it screws into the base of the motor.

The battlefield illumination missile system is an Army in-house development being carried-out here under the coordination of Picatinny Arsenal's Pyrotechnics Laboratory which is also responsible for the development of the parachute flare assembly payload. Other Picatinny Arsenal groups involved in the program are the Concepts and Applications Laboratory, aeroballistic problems, and the Artillery Ammunition and Rocket Laboratory, the propulsion system. Rock Island Arsenal is supplying the launchers and Frankford Arsenal, the fuses for the pyrotechnic package.

While most details of the new system are still secret, it is known that the illumination intensity of the flare package falls in the broad category of artificial daylight which places it somewhere above the light from a full moon or above a ground illumination of .025 foot-candles.

Heretofore, the job of battlefield illumination has been carried out by parachute flare assemblies ejected from the base of conventional artillery rounds such as 155-mm. howitzer shells. During the Korean War, the Army decided it needed sustained battlefield illumination capability and wanted to achieve this without diverting whole batteries of artillery pieces and men from their prime mission of supplying firepower.

Optimized System

Picatinny Arsenal was given the job of determining how this could be done in an optimized system that would provide the greatest illumination for the longest time over a given area at the lowest cost in manpower and dollars/hour and taking into consideration such things as the amount of weight a soldier would have to carry and over-all logistics problems.

Among other things, the group had to work out a three-dimensional geometric pattern concerned with the number of flares required per unit area, height of flares above ground, intensity of flares, rate of descent, and relation of one flare position to another.

One of the first parameters decided upon by the Picatinny group was the best "candle" for the job. The size of the candle fixed the rate of descent which in turn set the parachute size. In this way, the size and weight of the payload was determined. After similarly involved procedures, the group chose a ballistic missile as the carrier in preference to conventional artillery. Aircraft were ruled out, among other reasons, because of their vulnerability to weather and landing field limitations.

Schjeldahl to Build Echo II Satellites

Washington—G. T. Schjeldahl Co. has been awarded a $400,000 negotiated contract to design, build and test 135-ft., 500-lb. stiffened inflatable spheres for the National Aeronautics and Space Administration's passive communications satellite program.

The company, which built the Mylar gores for the Echo I passive satellite, will construct the Echo II spheres of .35-mil. thick Mylar plastic laminated on both sides with 0.2-mil. thick aluminum foil. The 136-lb., 100-ft. Echo was made of Mylar with an aluminum vapor deposit.

Suborbital ejection tests of the inflatable Echo II spheres will be conducted from Atlantic Missile Range with a Thor booster (AW Feb. 6, p. 23). First test launch of the sphere into a 1,000-mi. circular orbit will be made from the Pacific Missile Range next year with a Thor Agena B vehicle.

Sphere, more rigid, than Echo is expected to retain its shape for several years.

Discoverer Demonstrates Orbital Restart

Vandenberg AFB, Calif.—Discoverers XX and XXI which achieved, respectively, the longest duration in orbit and the first restart in orbit, also had the cleanest countdowns in the history of the series, according to Air Force Ballistic Missile Division.

The two successful launches were made less than 22 hr. apart. Tracking was good on both of the Lockheed Agena B satellites as they climbed into orbit, especially Discoverer XXI. The Pt. Mugu tracking station was able to pick up the signal from its transponder beacon from a great distance. The record of success was marred by the failure of the Discoverer XX capsule to re-enter the atmosphere on command.

The restart of Discoverer XXI was a one-second burst of forward thrust at the end of the satellite's first orbit which increased the period of the orbit from 93.8 min. to 97.8 min. The tangential acceleration increased the apogee to 670 mi. and the perigee to 155 mi. from altitudes that are unknown. Triggering the restart at the end of the first orbit eliminated any possibility of getting measured values for the first apogee and perigee. Ephemeris of the single orbit will be calculated from the early tracking data.

Discoverer XXI was a repeat of Discoverer XIX intended to collect data on background infrared radiation of the earth. The data are to be used in the Midas missile warning system and are being telemetered from the satellite to four stations at Kodiak, Alaska, Kaena Pt., Hawaii, Vandenberg AFB, Calif. and New Boston, N. H. The planned battery life for the satellite was two days. No attempt will be made to recover a data package from it. Aside from the restart provisions, Discoverer XXI was a standard Agena B weighing 2,100 lb. after all propellants were exhausted. It was launched by the last of the Block I Douglas Thor boosters developing 150,000 lb. thrust. In the future, Block II Thor space boosters developing 165,000 lb. thrust will be used in all Discoverer and other Agena satellite firings.

A Block II Thor was used to launch the heavier Discoverer XX. The weight of additional battery capacity and additional pressurized gas for the attitude stabilization system made it the heaviest of the Discoverer series at 2,450 lb. Extra duration was needed in the secondary power and attitude stabilization systems because Discoverer XX was left in orbit for four days, a day longer than any previous Discoverer. The weight of the 300-lb. re-entry capsule was unaffected. Discoverer XX had a 95.6-min. period, an apogee of 400 mi. and a perigee of 200 mi. No further efforts will be made to recover its capsule.

Explorer IX Photographed in Orbit After Its Tracking Beacon Failed

Washington—Excellent photographic tracking of the Explorer IX satellite was reported last week by the Smithsonian Astrophysical Observatory after initial fear that the Scout-launched payload had failed to orbit.

Early confusion on the 12-ft. inflatable sphere resulted when the solar-powered beacon failed to transmit and it became necessary to establish orbit by Baker-Nunn cameras and radar tracking. The satellite was launched Feb. 16 and confirmation that it had achieved orbit came the next afternoon, when it was named Explorer IX.

Launch was aimed at qualifying the solid-fuel, four-stage Scout as a satellite booster, and National Aeronautics and Space Administration propulsion officials said last week that data indicates precise performance by the rocket.

The sphere, developed by NASA's Langley Research Center, last week was in an orbit with an apogee of 1,607 mi., perigee of 394 mi., and a period of 118.4 min. The Millstone Hill tracking station has reported its radar observations indicate the sphere is fully inflated, and the scientific experiment on atmospheric density is being conducted with optical data.

A team headed by William J. O'Sullivan, Jr., who developed the sphere, is reducing the air density data based on orbital computations by NASA's Goddard Space Flight Center.

Launch of Explorer IX, which was the first launch of a satellite from Wallops Island, Va., and first use of an all-solid rocket vehicle to put a payload into orbit, was the fourth of eight development tests planned for Scout. Development includes a micrometeorite hazard satellite and backup (AW Feb. 20, p. 34), and two electron density probe experiments.

Scout inserted the 80-lb. payload container into orbit at an altitude of 1,280 mi., 10 min. 22 sec. after launch.

First stage Aerojet Algol burned 42 sec. and remained attached to the vehicle until ignition of the second stage Thiokol Castor, 70 sec. after launch at an altitude of 13,000 ft., when it was blast-separated. Second stage burned 41 sec., and the system coasted to 310,000 ft., when the third stage Hercules-Allegany Ballistic Laboratory Antares ignited, and the drag and heat fairing on third and fourth stages was jettisoned.

Third stage containing guidance package burned out 156 sec. after launch, and coasted 423 sec. to orbital altitude with the guidance system operating. Fourth stage was spun up to 150 rpm. by spin rockets 579 sec. after launch, and two seconds later the fourth stage Hercules-ABL Altair ignited to inject the payload into orbit.

Payload was ejected by a bellows and inflated by nitrogen gas in an operation identical to that planned in the third Scout test, which failed in December (AW Dec. 12, p. 33). Also in orbit is the fourth stage rocket casing, which contains a beacon and is being tracked by the Minitrack network.

Locations of Baker-Nunn cameras tracking the sphere are Jupiter, Fla.; Maui, Hawaii; Oregon Pass, N. M.; Olifants-Fontein, Union of South Africa; Woomera, Australia; San Fernando, Spain; Tokyo, Japan; Naini Tal, India; Arequipa, Peru; Shiraz, Iran; Curacao, Netherlands West Indies, and Villa Delores, Argentina.

Board Clears Pilot In Learstar Crash

Civil Aeronautics Board has cleared the pilot of a Johnson & Johnson Learstar, which crashed Dec. 15, 1958, and determined the probable cause was failure of anti-icing and de-icing systems to prevent and remove carburetor ice under atmospheric conditions.

The Learstar crashed during a snowstorm, about 5 mi. south of Woonsocket, R. I., killing five passengers and two crewmen. On Sept. 11, 1959, the Board found the probable cause was the decision of the pilot, Capt. Alex S. Sable, 38, "to continue on to his destination in freezing weather after total power loss of one engine from induction icing."

Contributing causes, the Board continued, were "a serious deficiency in weather briefing and inadequate information in the plane's flight manual for more efficient use of carburetor anti-icing and de-icing."

Case was reopened "in the light of new and pertinent evidence." In its conclusions, the Board found that there was no mechanical inflight failure or malfunction of the aircraft, its powerplants, or equipment.

Federal Aviation Agency has issued a directive applicable to all Lockheed Model 18 aircraft converted to Learstar configuration, restricting the aircraft against flying into known icing conditions until the carburetor preheat system has been modified.

Tri-Service VTOL Calls for Advances

By Larry Booda

Washington—Industry believes the complex requirements of specifications laid down for the tri-service VTOL transport might require major advances beyond the current state of the art.

Limits on weight, size and flight endurance imposed in the specifications will probably require a four-engine design with folding and tilting wings. Companies which have not already done preliminary research on their own will be hard pressed to meet the Apr. 3 deadline when proposals are due at the Bureau of Naval Weapons, which has technical responsibility for the project.

The tri-service VTOL contract will be worth $18 million to the winning contractor, with each service furnishing $6 million. Defense Department will release $3 million in the current fiscal year, and this is to cover preliminary engineering through the mockup stage. Cost of preparing the proposal will have to be borne by the company.

VTOL project engineers point out that although the requirements are complex, the program will not be complicated by the need for developing a production program along with the development effort. The transports will be evaluated without any pressure to complete an operational system. The contractor will build and demonstrate five aircraft, including prototype tooling, for testing under operational conditions.

Specifications for the VTOL transport include:

- **Maximum height** of 17 ft., maximum width of 30 ft. and maximum length of 50 ft.
- **Maximum weight** of 35,000 lb. Limits on dimensions and weight were governed principally by Navy requirements for shipboard operation. They were the subject of extended negotiations between the three services.
- **Cruising speed** at sea level, 250-300 knots; maximum speed, 300-400 knots. Air Force wanted a cruising speed of 300-350 knots.
- **Hover ceiling** out of ground effect, 6,000 ft. at military power and standard atmosphere.
- **Vertical thrust** to takeoff gross weight ratio, 1.05 to 1. Thus, vertical thrust in pounds must exceed the takeoff weight in pounds by five percent.
- **Combat radius,** 100 naut. mi. carrying 32 combat equipped troops.
- **Useful load,** to be determined by the bidder, but suggested as 8,000 lb. for passengers and cargo.
- **Mission fuel load**, sufficient to take off and fly at full power for five minutes, cruise to combat area at sea level, and then return with a 10% reserve.

Special features in the requirements are multi-engine reliability; automatic flight and boost control systems to reduce pilot fatigue; pilot, copilot and crew-chief accommodations; rear loading of wheeled vehicles, emergency flotation provision and minimum downwash velocity consistent with other requirements.

A variety of proposals is encouraged by the request for bids which permits wide bidder latitude in configurations, performance and powerplants.

Wide choice of engines allowable includes the Pratt & Whitney J60-P-3 and J60 (JT12A-7); General Electric J85-GE-5 without afterburner; Pratt & Whitney J52-P-6 and TF30-P-2; General Electric YT64-GE-2/6 and YT64-GE-4/8; Allison T56-A-10W/7/8; Lycoming T55-L-P/5; General Electric T58-GE-8; Lycoming T53-L-9 and T53-L-7.

Anti-icing and infrared suppression are two mandatory requirements for engine installations. Bidders must specify such approaches as bullet nose or other intake systems to combat ice. Infrared suppression, a military requirement to make the vehicle less susceptible to attack by heat-seeking missiles, involves tail pipe design. Plans for measuring radiation in either contractor- or government-owned facilities will have to be submitted with proposals.

Low radar reflectivity is stated as a desirable goal. However, developments in this area are primitive and impose weight penalties.

The competition holds no guarantee of production or use in military operations, since the aircraft are to be built only for evaluation under operational conditions. Contract will be for a phased development program, with aircraft sufficiently equipped to permit evaluation of operational suitability.

Following completion of the contractor's demonstration, approximately a year of operational suitability testing will be performed by the Air Force, Navy and Army at their installations and aboard Navy carriers. Contractor

Vertol Helicopter Chosen for Marines

Washington—Vertol Division of Boeing Airplane Co. was chosen by the Navy last week to produce a turbine-powered assault transport helicopter for the Marine Corps.

Contract has not been negotiated but specifications for the competition indicate that the helicopter will closely resemble the Vertol 107-II, which has been purchased by New York Airways.

Original specifications proposed by Navy's Bureau of Weapons limited the choice to an assault version of the twin-turbine Sikorsky HSS-2 anti-submarine helicopter, but criticism from industry sources last summer resulted in a change that permitted the Vertol 107 type to enter the competition.

The Vertol YHC-1B being built for the Army could not be considered because its 33,000-lb. weight and length of 51 ft. with rotors folded would not permit its operation aboard Navy assault ships.

The Marine helicopter will be powered by two General Electric T58-8 gas-generator free-turbine engines developing 1,250 shp. each. Principal innovation will be power-operated folding rotors. Navy assault ships have limited elevator dimensions and hangar deck space, necessitating the design of more complex rotor systems that incorporate a weight penalty.

If usual Navy practice is followed, the helicopter will be designated HR2P-1.

As an assault transport the fuselage will be fitted with 26 seats. Number of troops actually carried, however, will vary with the combat radius demanded by the mission. For a typical 100-naut.-mi.-radius operation the payload will be 5,304 lb. out of a gross weight of 18,450 lb.

With a reduced useful load the combat radius would be extended. It is anticipated, however, that an average mission would be 75-naut.-mi. radius, allowing all seats to be filled.

Cruising speed will be 130 kt. for most efficient fuel consumption with a top speed of 145 kt. Servicing ceiling will be 13,700 ft. at normal rated power and standard atmosphere. Hover ceiling out of ground effect will be 6,500 ft. Engine-out ceiling will be 2,700 ft. and the vertical rate of climb will be 1,240 fpm.

There is a ramp at the rear of the fuselage. Water takeoffs and landings will be possible because the hull will be sealed and have stabilization sponsons to prevent capsizing.

Fuselage length with rotors folded will be 44 ft. 7 in. The inside cabin height will be 6 ft., width 6 ft. 7 in. and length 24 ft. 2 in. Total volume of the cabin will be 1,034 cu. ft.

support will be required during this period.

Engineering proposals will have to state specifically empty weight and performance which the bidder is willing to guarantee.

Athough cost proposals may be made on the basis of cost plus fixed fee, the request for proposals strongly emphasizes that bids made on the basis of a fixed fee or reasonable cost sharing will be encouraged. Fixed fee contracts are no novelty to the construction business, but to the airframe and aerospace propulsion industry such a contract for a complete air weapon system would be a radical departure. Recent policy statements by the Air Force and the Navy have indicated that increasing pressure toward this type of contract will be exerted in the future.

The covering letter with the request for proposals emphasizes that any communications regarding additional details of the competition should go to the Bureau of Weapons and not the individual services. This precautionary statement is due to the fact that the final requirements were the result of compromises reached in preliminary discussions of a tri-service group (AW Nov. 28, p. 31).

As recently as the middle of January, the three civilian research and development heads, Richard S. Morse of the Army, James H. Wakelin of the Navy, and Courtland D. Perkins, former USAF research and development chief, made adjustments in the requirements before finally approving them. Perkins is generally credited with being the moving-force behind the program.

In preparing requests for proposals in the VTOL field, the Bureau of Weapons was faced with the problem that no flying qualities requirements or design data requirements exist for such aircraft. For fixed-wing aircraft, MIL-F-8785-4 (ASG) applies, and for helicopters, MIL-H-8501A is in effect. These documents contain standard interservice requirements.

Rather than produce a new document before methods of propulsion, lift and aircraft configuration have settled into a pattern, Bureau of Weapons issued modifications to the existing documents as appendices. In the case of conflict between the documents, the more stringent requirement will govern.

In the flight regime, main differences shown by the appendices include:

- **It must be possible** to maintain smooth, steady flight over a speed range from at least 30 kt. rearward to forward transition speed. The fact that transition speed is mentioned precludes a radical departure from present VTOL concept, since it assumes a forward stalling speed, a characteristic of aerodynamic lift surfaces. This requirement applies to fully powered flight as well as to partially powered flight assuming the loss of the most critical engine.
- **It must be possible** to easily and safely accelerate rapidly to transition speed and decelerate similarly at constant altitude without encountering undesirable stalling or buffeting characteristics. It must also be possible to readily and safely stop conversion and make steep descents to landing with adequate control.
- **As a guide** for the conditions of flight to be investigated, flights will be made at 0, 20, 30, 40, 50, 60 and 70 kt. on the level and at various rates of descent at partial power to at least 500 fpm. at the most critical center of gravity position.
- **In place of "collective pitch,"** a term applied to helicopters, "height control" has been substituted. The height control must be capable of remaining fixed at all times unless moved by the pilot. It must be essentially irreversible to keep it from creeping.
- **Stability definitions** have been changed to require both fixed and rotary wing characteristics.
- **Short takeoff and landing** capability is defined in terms of control force limits. For STOL operation, rudder or other control must be sufficient to permit 10 deg. of sideslip and to maintain straight paths over the ground in crosswinds up to 35 kt.
- **Roll capabilities** in high speed operation call for attaining at least a bank angle of 50 deg. but not greater than 160 deg. in one second.

Design data requirements for the aircraft include reports on aerodynamic and flutter investigation programs. Bidders must state whether government or privately-owned facilities will be used. Models for these programs must be suitable for scale testing and for providing answers applicable to full size models.

Within 60 days of the award of the contract, the successful bidder will be required to submit drawings and basic performance data reports. Later, standard aircraft characteristic (SAC) charts will be forwarded to Bureau of Weapons on request, with 30- to 60-day periods allowed for their preparation.

Structural tests required will not vary greatly from past practices. Control system fatigue tests will include application of oscillations to 30 million cycles at 1.5 times the maximum maneuvering load or three times the maximum steady state flight load, whichever is more critical.

Bench tests for the main and antirotor hub and shaft, blades, attachment fittings, dampers, supports, hinges, servo flaps and other rotating components will be made to substantiate 250-hr. life prior to demonstration, 500-hr. life prior to first delivery and 1,000-hr. life within six months after initial delivery.

Before release for contract demonstration, at least 50 hr. of flight in a single aircraft must be made. Prior to service trials, at least 100 hr. of the most severe prolonged flight operations are required on a single aircraft.

Human factors are taken into account and do not differ materially from those for other aircraft.

Reliability levels of each subsystem will be periodically checked and proved.

General Electric Names Apollo Subcontractors

Washington—General Electric Missile and Space Vehicle Department has selected 13 major subcontractors to participate in feasibility design studies for the multi-man Apollo spacecraft.

General Electric, Convair and Martin were awarded separate study contracts last fall (AW Oct. 31, p. 31). Reports on the studies are due in May.

Subcontractors named by GE and their areas of responsibility are:

Bell Aerosystems Co., glide vehicle design and liquid propulsion; Aerojet-General Corp., solid propulsion; Thiokol Chemical Corp., attitude control propulsion; Lear, Inc., displays and controls; Burns and Roe, Inc., ground facilities; Link Division of General Precision, Inc., crew training; Richie and Associates, human factors, and Astronautics Corp. of America, re-entry energy management.

General Electric departments participating are Defense Systems, tracking; Heavy Military Electronics, ground communications; Light Military Electronics, vehicle communications and guidance and control; Ordnance, guidance and control, and General Engineering Laboratory, radiation phenomena and shielding.

De Havilland Planning Jet Executive Aircraft

De Havilland Aircraft Co. is aiming its DH-125 twin-turbojet executive transport at the $500,000-segment of the U. S. market.

The DH-125 would carry 6-8 passengers and a crew of two, and it is regarded as a replacement for the company's Dove executive transport. The new aircraft has a gross weight of about 18,000 lb. and a range of about 1,100 naut. mi. Now in the mockup stage, it is to make its first flight next year, and deliveries are to begin in 1963.

The aircraft is to be powered by two Bristol Siddeley Viper Mark 20 turbojets, mounted on the sides of the rear fuselage. The engine is being developed from the Mark 10 version, and it is to produce about 3,000 lb. of thrust.

Defense Department Accelerates Spending

Washington—Defense Department moved last week to accelerate military procurement and construction spending in line with President Kennedy's anti-recession program.

Defense Secretary Robert S. McNamara directed the service secretaries to award certain construction and procurement contracts 2-3 months in advance. These contracts involve $650 million for procurement and $40 million for construction from currently available funds, and most of the accelerated spending is to be initiated within 30 days.

Rolls Discloses New RB.153 Design Data

New details on Rolls-Royce bypass engine layouts for VTOL applications show two unusual uses of the ducted-fan principle to obtain both vertical lift and horizontal thrust from the same powerplant.

Most favored design is the use of a special type of high bypass propulsion engine—possibly the RB.153—in which the bypass flow is diverted to a multi-stage reaction air-turbine driving a ducted fan as the last stage. In cruise the bypass flow is ducted to a separate propulsion nozzle alongside the engine.

In this arrangement it appears that the front multi-stage fan providing the bypass air is entirely separate from the gas system of the propulsion engine; the two flow systems having separate concentric intakes.

With this type of lift fan, the primary and secondary effluxes from the air turbine and the ducted fan stage have a very low mean velocity of the order of 600 fps. Although low velocity efflux increases the specific weight, it greatly enhances the hovering efficiency which is not only essential for a transport, Rolls said, but gives flexibility of operation to a tactical aircraft.

The RB.153, which reports suggest is scheduled for the multi-engined Boelkow-Heinkel-Messerschmitt VTOL project, is believed to be the prime mover associated with this lift/thrust arrangement.

Patent illustrations which were issued last week illustrate another arrangement in which the whole flow from a propulsion engine is diverted through a very simple valve to a duct perpendicular to the propulsion duct which terminates in a turbine driven ducted fan, similar to that of the air-driven lift fan.

In the propulsion regime the efflux continues down the horizontal jet pipe and expands across another multi-stage turbine driving a ducted fan as the last stage. The fact that this patent has now become available, however, suggests that no further development of this layout is intended.

Johnson's Transport Crashes at Ranch

Dallas—Vice President Lyndon B. Johnson's executive Convair 240 crashed on a ferry flight from Austin, Tex., to Johnson's ranch airstrip last week, killing the two pilots just after they decided to return to Austin because of low visibility.

The Convair 240, a former American Airlines transport Johnson had equipped with weather radar, was flying to the ranch to carry the Vice President to Washington. The airstrip lights were on, but the crew couldn't see them and decided to return to Austin just before crashing in the hilly country 7 mi. southeast of the strip.

In another accident last week, an R4Y-1, Navy version of the Convair 340, carrying Navy Under Secretary Paul B. Fay, overshot the runway at a small Atlantic City, N. J. airport and stopped with its nose in 7-ft. of water in the inland waterway. The aircraft lost radio and navigation aids and couldn't land in fog at Washington, D. C. After fog kept it from landing at Dover, Del., the R4Y-1 lost all electrical power and had to land at Atlantic City's Bader Field without propeller reversing. Only casualty was the pilot, who broke his ankle.

News Digest

Lufthansa will buy 12 Boeing 727s with the first six to be delivered in summer of 1964 and the remainder in summer of 1965 (AW Feb. 6, p. 60).

Richard S. Morse, director of Army Research and Development, was nominated to the new post of assistant Army secretary for research and development last week, raising him to the rank of the top Air Force and Navy managers in this field.

United Aircraft Corp. announced that it will change the name of its wholly-owned subsidiary, United Aircraft Export Corp., to United Aircraft International, Inc. Name change is to become effective Mar. 1.

Cabin of a TWA Boeing 707-120 was gutted last week by fire which broke out as the aircraft was being readied for temporary storage at San Francisco. Damage was estimated at $500,000. Fire apparently was caused by defective wiring in the rear of the cabin.

French Air Ministry last week successfully launched the first of four Veronique rocket-boosted capsules containing a white rat (AW Jan. 16, p. 105) from its Colomb Bechar launch site in the Sahara. The rat survived the flight, which had a 95-mi. apogee and 27-mi. range.

Allison 501-D13 turboprop engines will be installed in five Federal Aviation Agency Convair 440 aircraft under a $3-million FAA contract to Allison Division of General Motors Corp.

British Overseas Airways Corp. is relinquishing its 40% interest in Ghana Airways at the request of the Ghanaian government (AW Feb. 1, 1960, p. 33).

Army-Martin Pershing was almost completely guided by its inertial guidance system in the successful second flight of the missile with the inertial system aboard.

USAF-Martin Titan J landed less than a mile from its target point last week after a 5,000 mi. flight down the Atlantic Missile Range. The missile was launched after a countdown that was completed with no holds.

Mobile Radar Bomb Scoring equipment mounted on railroad trains will be used as targets for Strategic Air Command bombers in Oil Burner low level training operations. First RBS train will go into operation early next month near Milan, Tenn.

German Helicopters

Bonn—Over-all West German Defense Ministry decision on its future helicopter needs, hanging for the past six months, has been delayed again with the newest target date extending into mid-March or possibly later for technical review.

The review concerns helicopters in heavy, medium and light categories and largely revolves around the issues of whether to order additional quantities of piston helicopters or aim for an all-turbine fleet, cost, and whether to buy U. S. equipment or favor France, with which it and Italy have an agreement for common helicopter development projects. However, the Sud Frelon, a competitor of the S-61 and Vertol 107 in the heavy category, will not be available until late 1963 or 1964.

In the medium piston helicopter range, British officials recently succeeded in having the Germans agree to evaluate the Westland Wessex, essentially a Sikorsky S-58 built under license along with the original competitors, the S-58 and Vertol H-21.

Strike Climaxes Pilot-Engineer Dispute

President Kennedy intervenes to force settlement of airline industry's most crippling labor fight.

By L. L. Doty

Washington—Long-standing bitter feud between the Air Line Pilots Assn. and the Flight Engineers International Assn. reached a climax last week in a six-day wildcat strike by the engineers that ended with an estimated $35-million revenue loss to the airline industry.

In a last-ditch fight for survival, the determined engineers staged a walkout from seven major airlines that crippled the nation's air transportation system and had far-reaching effects on the national economy. The strike heaped a mounting traffic burden on the railroads, clogged highways, forced delaying diversions of air mail deliveries and created a rash of empty rooms in winter resort hotels.

Estimated loss to the airline industry in gross revenues ran as high as $5 million daily. Close to 100,000 airline employes were laid off in mass furlough programs. The paralyzing strike, most serious in commercial airline history, was ended through intervention by President Kennedy and engaged the full-time efforts of Labor Secretary Arthur J. Goldberg in a continuing search for settlement.

Mediation Board Decision

Crux of the problem is a National Mediation Board decision authorizing members of the engineers and pilots unions at United Air Lines to vote for a single union as bargaining agent (AW Feb. 13, p. 38). Engineers view the order as a death-blow to their union since the pilots greatly outnumber engineers on all airlines and appear sure to win any elections held to choose a single flight crew union.

Legally, there is no escape from the federal ruling, so the angry engineers chose to demonstrate their protests to the NMB decision by walking out in defiance of FEIA officials' pleas to return to work, restraining orders secured by the carriers involved and damage suits. Punitive action was taken in Miami by Federal Judge Emett C. Chote, who fined the Eastern Air Lines chapter of FEIA "$200,000 or whatever is in your treasury" for failing to comply with an injunction against continuing the strike.

Late last week, a subpoena was served on FEIA President Ron Brown ordering him to appear in U. S. District Court here to explain what had been done to end the engineers strike against Pan American World Airways. It was this walkout on Feb. 17, in the face of a presidential order for a 60-day cooling off period, that started the chain reaction of walkouts against six other carriers—American, Trans World, Eastern, National, Flying Tiger and Western Air Lines. Pay, rules and working conditions are the issues behind the Pan American labor dispute.

President Kennedy named a three-man commission last week to study the strike issues during a 90-day cooling off period. At the same time, Goldberg gave the engineers assurances that he had been told by six of the carriers that no company disciplinary action would be taken if they obeyed back-to-work requests under the Kennedy plan. The other airline, Western, discharged all its engineers and began a program of hiring and training pilot-qualified engineers.

It was the Western action that delayed White House attempts to reach a settlement, since the engineers consistently refused to sign the Kennedy agreement unless all airlines did likewise.

Late last week, other carriers followed the Western lead and gave the engineers an ultimatum that unless the men returned to their jobs at once, they would be cut from payrolls. Engineers agreed to return to work Feb. 23, and all carriers but Western joined in the agreement.

Goldberg said the position of the engineers was "understandable" but he hoped the new panel would "serve the interests of everyone involved, including the public." He noted that the National Mediation Board decision could not be changed by the President, but only by court action, and he said that there was no "legitimate" reason why the engineers did not return to their jobs.

Accepting the agreement, the engineers were still cool toward Kennedy's peace formula. They held that the three-man commission was chiefly an advisory group and had no legal authority to overrule the NMB decision which, they claimed, has the full force of the law behind it. Only a reversal of this decision will make the engineers happy, but such action is unlikely and most observers are now pessimistic over the future of the union as a bargaining agent for flight engineers.

The airlines have become weary of the pilot-engineer jurisdictional squabble, which reached its first crucial stage with the third-pilot issue when turbojet contracts were being negotiated. One airline executive told Aviation Week that he believes the reason behind the current cockpit fight lies in American Airlines' haste to get its jets into service ahead of the competition. He charged that the carrier's easy capitulation to ALPA's demand for a third pilot is the direct cause of the dispute.

Continental's Solution

Continental Air Lines succeeded in breaking away from the union last year when it continued to operate schedules in the face of a 138-day strike by 22 flight engineers. The airline used pilot-qualified engineers during the strike, and, when it ended last fall, five of the striking engineers took severance pay and the remaining 17 took pilot training and rejoined the company under ALPA jurisdiction.

Pressures for a merger between ALPA and FEIA will grow in the wake of Continental's success and the NMB decision. In Miami last week, George Meany, president of AFL-CIO, with which FEIA is affiliated, said organized labor has been trying for 22 years to place all commercial flight personnel under one union and added that he saw no other way of resolving the current issue.

Whether the engineers can continue to resist these pressures for any length of time remains a matter of conjecture, but some settlement of the jurisdictional cockpit dispute now appears inevitable. Chapters of FEIA had this choice to make last week: the risk of being swallowed by ALPA by going back to work under the terms of the Kennedy agreement, which gives no guarantee that the NMB decision can be changed, or run the chance of being cut off carriers' payrolls by staying out on strike.

Airlines which chose to require pilot-trained flight engineers for turbojet aircraft were unaffected by last week's strike and were the envy of the strike-bound carriers. Presumably, contracts with the FEIA deterred the struck airlines from making any direct move toward assigning other flight personnel to the engineer job during the opening days of the strike. Carriers which continued to operate were Braniff, Continental, Capital, Delta, Northeast and United.

Northwest Airlines engineers, who are represented by International Assn. of Machinists, withdrew from their positions on all jet aircraft Oct. 11, and from the cockpits of all Northwest aircraft Jan. 9.

Status of Negotiations

Most of the remaining carriers were either in mediation or had open contracts when last week's strike began. Here was the status of contracts at that time:

- **American** and the engineers were in mediation. Negotiations covered the airline's agreement to reopen the contract once turbojet equipment was in operation. Issue balking efforts to reach agreement stems from a dispute over which proposals can properly be opened under the agreement. American has submitted the matter to the System Board of Adjustment following a National Mediation Board recommendation that the issue be decided by a "competent tribunal."
- **Eastern and FEIA** resumed negotiations Jan. 16.
- **FEIA rejected** an NMB offer of arbitration dated Jan. 9 in its dispute with Pan American. It was accepted by Pan American on condition that the company would establish the issues to be arbitrated. In mid-January, NMB terminated its participation in the case but called the attention of both parties to a provision in the Railway Labor Act requiring that the status quo remain in effect for at least 30 days. It was the day after the 30-day period and the day the strikes began, that President Kennedy issued his appeal to the engineers to return to work for a 60-day cooling off period.
- **TWA also is involved** in reopening of its contract with the engineers' union on the turbine equipment issue. FEIA has been temporarily enjoined from striking over the demands made in its proposals for reopening. No hearing has been held to determine whether this injunction should be made permanent. Negotiations on the basic agreement ended Dec. 22, and both TWA and the union have applied for mediation.
- **Western was scheduled** to resume negotiations four days after last week's strike began. Chief among Western's demands has been that engineers become pilot-qualified.

CRIPPLED airline service resulted in widespread cancellations. Stranded Idlewild passengers are shown "waiting it out." Volume of no-shows multiplied rapidly.

Meanwhile, carriers still in operation were not enjoying the traffic bonanza they had expected with six of their competitors either fully or partially grounded. American, Eastern and TWA were shut down completely. National, Pan American and Western were operating sharply curtailed services during most of the week.

Poor weather—dense fog and rain—disrupted the first wave of extra sections mustered into service by the operating carriers at the beginning of the week, and three hub airports—Boston, New York and Washington—were periodically closed to all traffic for several hours.

The delays and cancellations spread throughout each carrier's system, forcing reshuffling of flight schedules and also necessitating rebalancing of aircraft fleets.

No-Shows Multiply

By mid-week, the volume of no-shows reached prodigious heights, primarily because of a loss of connecting passengers and a general impression that the entire industry had been grounded by the strike.

Northeast experienced no rush of stranded passengers, and during most of the week, load factors remained good but not spectacular. A second Boeing 707 transport was leased from TWA to back Northeast's fleet of six Convair 880s and the other Boeing it had rented from TWA in anticipation of a traffic demand that had not fully materialized late last week.

Braniff operated full capacity over the weekend the strike began, but during the week, the volume dwindled back to normal. Braniff's management was highly critical of press coverage of the strike, charging that stories failed to name the services still operating and available.

Delta's Traffic Grows

Delta's extra sections were grounded by weather at the opening of the week, but the airline gradually showed a steady traffic rise during subsequent days.

Capital was plagued with a no-show problem, and United, providing the only transcontinental air service, operated during the first portion of the week with a number of empty seats.

Local service airlines recorded some traffic increase but, in the words of an Allegheny Airlines official, the "rise has been nowhere near our expectations."

Keith Kahle, president of Central Airlines, told Aviation Week that the flight engineer hassle has "ruined interline business."

TWA shut down operations Monday and promptly issued notices of furlough to the majority of its 20,000 employes. On its domestic and international routes, TWA averages 210 originating flights daily for a total of 15.5 million passenger miles. TWA management staff took a 65% pay cut for the duration of the strike.

American Airlines furloughed all but a few of its employes Monday. The carrier estimates its loss of revenues to total $1 million daily. Pan American furloughed 20,000 people but re-opened its ticket offices for the handling of future reservations. Some of the airlines, continuing to operate, hired furloughed employes of other carriers on a temporary basis to help handle the

Westland Emphasizing Stub-Wing Belvedere 194

Westland 194, a stub-wing variant of the Bristol Belvedere Type 192 going into squadron service with the Royal Air Force this year, is being developed as a priority project by Westland. Powered by four de Havilland Gnome turboshaft engines, the Type 194 retains the tandem-rotor configuration, and will carry 50-60 passengers. Fuselage has been lengthened to 80 ft. and deepened to improve seating. The 40-ft. wing span provides pitch stabilization as well as substantial unloading of the rotor during cruise. Westland 194, shown as model above, is expected to see service by 1964.

anticipated rush of new business.

Western was virtually shut down and by Wednesday was handling only two flights daily. Thursday, 2,350 employes, or 80% of its total personnel, were furloughed. Here are extracts from the letters sent by Western President Terrell Drinkwater to Goldberg, the National Mediation Board and the Civil Aeronautics Board:

"Our service was abruptly halted Friday night without notice . . . the strike against Western is illegal, irresponsible and does great violence to the public interest . . . the furloughs are necessary in order to preserve the company's funds during this period of emergency when practically no revenues are coming in . . . the services of all flight engineers who have refused to fly their assigned trips have been terminated . . . Western is employing and training, as fast as possible, pilot-qualified engineers . . . as these engineers receive FAA certificates, they will start to fly on regular schedules . . . it is our intention to provide some service over those portions of our system where no service exists by other airlines and gradually restore full service to all routes."

25% Pay-Cut

National furloughed 3,400 of its 4,000 employes. Eastern Air Lines senior management staff took a 25% pay-cut for the duration of the strike.

It is still too early to evaluate the full economic impact of the strike on the industry, but the effects could well be catastrophic because by mid-week it was apparent that travelers were either delaying their travel plans or were switching over to surface transportation so that revenues which might have gone to carriers still in business were going elsewhere. The substantial loss in business will undoubtedly result in a stringent tightening of purse strings for many months as the industry strives to recoup. The situation is anything but helpful to an industry already on the brink of heavy deficits.

Despite the fact that both TWA and Pan American had brought all North Atlantic schedules to a complete standstill, international travelers were either slow in switching to foreign flag carriers or canceled their travel plans entirely. Neither foreign flag airlines serving the North Atlantic nor steamship companies reported any unusual increase in business.

Committee Approves Halaby Nomination

Washington—Senate Commerce Committee last week unanimously approved the nomination of Najeeb Halaby as administrator of the Federal Aviation Agency.

Halaby outlined these views during committee hearings on his nomination:

- **Airport construction.** He favors a shift in emphasis in the allocation of federal aid funds to aspects specifically aimed at improving air safety, leaving the financing of comfort and convenience facilities to local communities. His recommendations are now under consideration at the White House. A Republican-sponsored measure authorizing $70 million a year in federal funds for airport development "necessary in the interests of public safety" is "in the right direction," he said. The present airport act, which expires June 30, provides $63 million a year in federal funds.
- **Lockheed Electra.** Halaby gave the aircraft high endorsement as "sound, healthy, and relatively easy to fly." He said that he piloted the Electra under conditions simulating those which led to major accidents.

"I went 50 knots beyond the safe speed, through gusty air and into a steep dive," he told the committee. "This aircraft is the backbone of our short-range air fleet. It is in competition with foreign types. It is a sound airplane, and public confidence in it is very important." Halaby declined to revise his opinion under questioning by Sen. Vance Hartke (D.-Ind.), who has been critical of the Electra.

- **Scientific technicians.** The civil service ceiling of $19,000 a year for top scientists, he said, could hamper FAA's airways development program. The comparable industry salary is $45,000 a year, he said. He noted that Air Force, by establishing Aerospace Corp. as a non-profit organization to give technical direction to its ballistic missile programs, is able to break the civil service ceiling and pay scientists $40,000 a year.

CAB Issues Order On New Subsidy Formula

Washington—Civil Aeronautics Board took its last procedural step last week toward adoption of a new subsidy formula for local service airlines when it issued findings and show cause order in the Local Service Class Subsidy Rate Investigation.

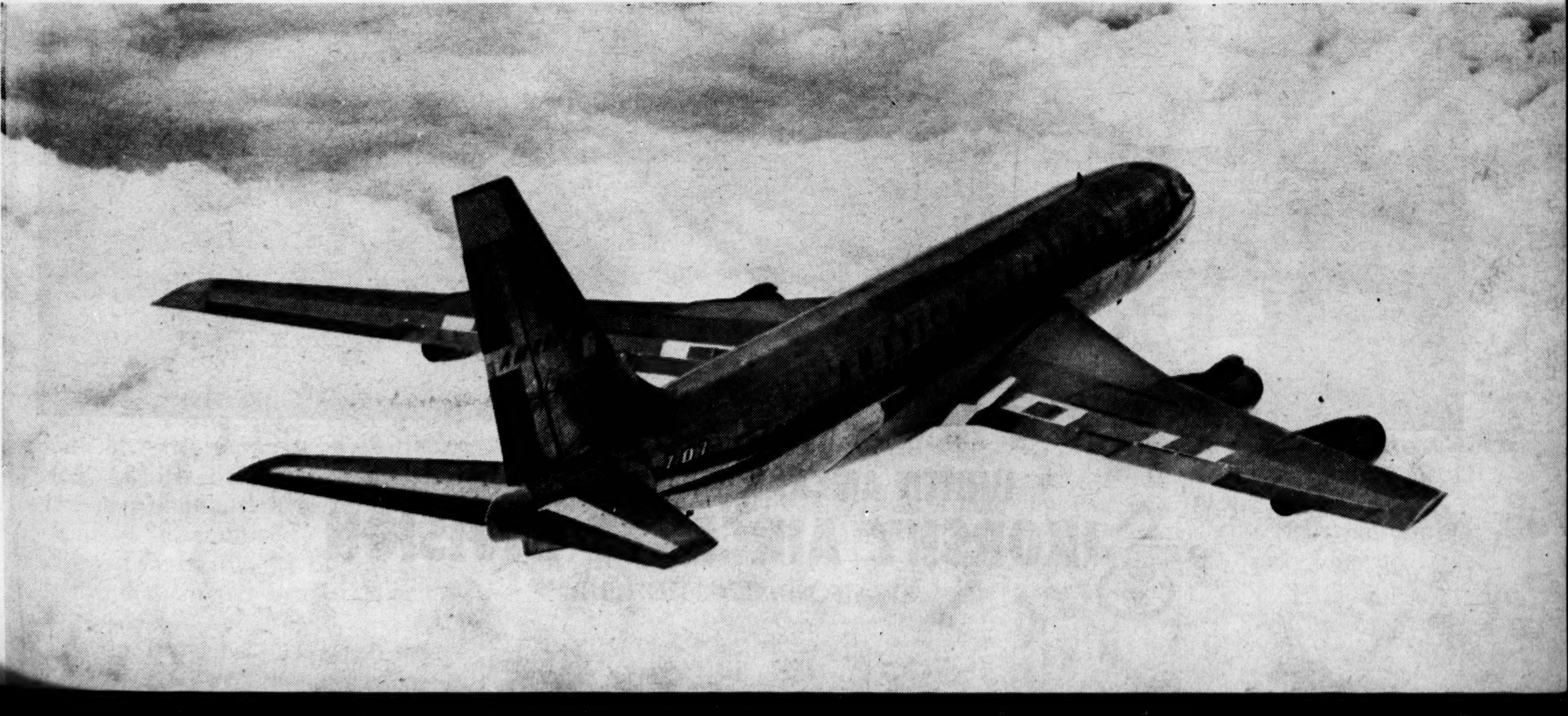
Thirteen local service airlines have been notified by CAB that they have until Mar. 27 to file any objections they have against the class mail rate plan (AW Jan. 2, p. 29) before it is implemented, retroactive to Jan. 1.

American Airlines' first 720B, powered by Pratt & Whitney JT3D turbofan engines, takes off with leading edge flaps extended. Turbojet 720s are in service with American, but this airplane is the first delivered off-the-line from Boeing with the fan engines.

First Boeing 720B Delivered to American Airlines

AMERICAN
ASTROJET
N7538A
AIRLINES

Four 720Bs and two 707-123s retrofitted with turbofan engines will go into service Mar. 12 on New York to Los Angeles, New York-Chicago and Chicago-Mexico City routes. All will be designated 707 Astrojets by American without distinction between versions. Improved takeoff performance is permitting American to begin its first jet service to Mexico City. Besides the engine change, the 720B wing leading edge is modified between root and inboard engines as view from above indicates.



***TRIPHIBIOUS SUPPLY LINE*—sea, air and land.** **For the Army Transportation Corps, Sikorsky's S-60 *Skycrane* recently lifted a Conex container from the hold of a ship at sea; minutes later placed it in a truck ashore. The S-60 can carry five tons. The next *Skycrane,* the turbine-powered S-64, will lift up to ten tons. Future designs will carry up to 40 tons. Loads can be carried by cargo hook, or in pods for transporting complete units such as field hospitals, communications centers or personnel.**

UNITED AIRCRAFT CORPORATION
SIKORSKY AIRCRAFT DIVISION
STRATFORD, CONNECTICUT

Monroney Demands Action on Air Safety

By Robert H. Cook

Washington—Immediate action to reduce the nation's growing aircraft accident rate through more efficient use of existing personnel, equipment and regulations, was demanded last week by the Senate Aviation Subcommittee in hearings which probed Civil Aeronautics Board and Federal Aviation Agency cooperation in accident investigations.

Chairman A. S. Mike Monroney (D.-Okla.) called the recent mid-air collision between a Trans World Airlines Super Constellation and a United Air Lines DC-8 in New York "the most important in airline history," and said it spotlighted deficiencies of the present air traffic control system.

Sen. Monroney concentrated the first three days of hearings on determining what safety recommendations have been made by CAB to FAA as a result of the Board's accident investigations.

Steps suggested by Sen. Monroney to improve aviation safety, pending full development of more precise electronic aids and traffic procedures, followed this general pattern:

- **Agencies should seek authority** to close airports under below-minimum weather conditions.
- **Airports that fail to install** needed safety aids for landings and takeoffs should be closed under existing CAB and FAA powers.
- **Radar monitoring of aircraft** over terminal areas should be strengthened by increasing controller personnel and duties.
- **Rate of traffic acceptance** should be slowed over heavily congested terminal areas to assure a greater safety margin.
- **Transponder equipment,** carried by turbojets as a radar target for ground controllers at any one airport, should be better utilized to provide other controllers at nearby airports with a double check on the aircraft's identity and position.

Safety Bureau Understaffed

CAB told the subcommittee that a heavy volume of accident investigations has prevented it from concentrating on ways to promote safety among the airlines. Lack of sufficient personnel in the Bureau of Safety, which last year logged 13,000 hr. of overtime, has caused this situation, CAB said.

The problem is expected to get much worse since the Board also is charged with investigating general aviation accidents—which produced a fatality rate last year double that of the air carriers—but is "ill equipped" to do so, CAB witnesses said.

Emphasizing the need for an increased staff to handle this mounting workload, Melvin Gough, chief of the safety bureau, said fatality statistics alone do not give a complete picture of the Board's workload. The non-fatal crash of an American Airlines Electra last Sept. 16 at LaGuardia Airport, and the takeoff crash of an Aeronaves DC-8 turbojet, which claimed the lives of four crew members, but spared 102 passengers, at Idlewild International Airport on Jan. 19, could have boosted the fatality rate by 50% if all those on board the two planes had been killed, Gough said.

This opened the way for a series of questions on airport and terminal area accidents and prompted Sen. Monroney to observe that more than 40% of accidents happen during some phase of landing or takeoff, but are "often overshadowed by more spectacular accidents."

LaGuardia's lack of sufficient landing aids came under heavy fire from Monroney after CAB investigators testified that the American Electra struck the top of an 8-ft. dike while attempting to "land short" on a 4,900-ft. long runway, because of construction work at the airport.

The Board later recommended to FAA the installation of a Visual Glide Slope system that might have prevented the crash had it been there last September, investigators said.

Sen. Monroney said LaGuardia is the "most notorious example of failure to provide adequate safety aids" and that the Air Line Pilots Assn. has severely criticized it for this failure. He expressed concern that neither CAB nor FAA had taken any earlier action to insist that the equipment be installed.

He urged CAB and FAA to compel "foot-dragging" local officials to install the needed safety aids at high-density airports and suggested that the agencies seek means to close airports which fail to comply with their orders.

Sen. Monroney said the agencies might consider requesting authority to close airports on their own weather judgments or formulate a type of emergency power to deny takeoffs on an individual basis. CAB also should examine more closely the practice of allowing pilots to fly while their license appeals are being considered by the Board.

The bulk of Monroney's criticism and recommendations on air traffic control came after CAB investigators, reviewing the TWA-United accident, testified that the United DC-8 was not given a complete radar monitoring into its assigned holding pattern "because this would slow down the entire traffic system."

They added that the Preston holding pattern, which the DC-8 passed at an estimated speed of 446 kt., is covered by the Idlewild approach control radar scopes, which could have spotted the United turbojet. But current operating procedures do not include an automatic radar monitoring into holding patterns unless this is requested by the pilot, they said.

"It seems to me," Sen. Monroney said, "that we're in such a great rush to accommodate a large volume of traffic that we do less than is humanly possible to be certain that planes are in their right positions. They are so crowded, radar has no time to watch for a possible overflight of a vital point, even though it may mean life or death for 100 or more people."

Better Radar Control

Sen. Monroney noted that a CAB time sequence of ground instructions to the United aircraft, as compared with its high speed and distance from the holding pattern, showed that the pilot would have had less than one minute to locate the proper bearings for the assigned holding pattern.

"We should take a closer look" to determine if radar controllers should not be given extra duties, using current equipment, to prevent a recurrence, he said. This might even be handled by having another controller look over the shoulder of the regular operator until better equipment, such as three-dimensional radar, is available, the Senator said.

Testimony that CAB investigators, who duplicated the United aircraft's flight path and time sequence to Preston in a DC-8, had to use strong reverse thrust in order to make the pattern's turns also brought more criticism. Sen. Monroney questioned the close proximity and narrow confines of holding patterns for jet operations. He suggested either delaying of landings in the heavily congested New York area or routing of some air traffic over the nearby Atlantic Ocean prior to landing, to avoid the danger of collisions that could result from too little separation between holding patterns.

Sen. Monroney asked CAB to explore the possibility of expanding capability of transponder units to include both aircraft identification and altitude.

Sen. Monroney also approved a CAB idea to have transponders on all aircraft approaching New York used as a "double check" for their positions by both LaGuardia and Idlewild radar controllers.

National-Pan American Rift Widens Over Disposal of Exchanged Stock

Washington—Growing rift between National Airlines and Pan American World Airways over the disposal of stock traded in a stock exchange agreement widened further last week when National turned down Pan American demands to re-exchange the stock.

National has told the Civil Aeronautics Board it plans to sell the 400,000 shares of Pan American common stock acquired under an agreement between the two carriers. This action was taken after the Board disapproved the stock exchange portion of the transaction (AW Feb. 13, p. 39). The agreement also provides for the mutual leasing of turbojet aircraft, which the Board approved.

In a letter to G. T. Baker, National's president, Roger Lewis, Pan American executive vice president, challenged National's right to sell the stock and declared that "the only method of divesture which has Civil Aeronautics Board approval is the re-exchange of shares."

Baker countered in a letter last week to Pan American that there is nothing in the agreement which requires that the stock be turned back. He termed as "understandable" Pan American's "chagrin at the failure of the Civil Aeronautics Board to permit you to retain the stock in a domestic trunk airline . . . and your dissatisfaction with the present disparity in market value" between the shares of the two companies.

Potential Loss

Throughout his letter, Lewis emphasized that National was the recipient of all the benefits of the agreement while Pan American had gained no advantages. He said his company could not accept major modifications, all to its detriment, and that any sale of Pan American's shares would involve a "potential loss of some $4 million to Pan American, in view of the price of National's stock at the present time."

Baker replied that National will live up to the agreement and expects Pan American to do the same. He added:

"National feels certain that you would not for a moment attempt to renege on the agreement if the market value of the National shares were in excess of the Pan American shares." He concluded by warning that if Pan American does not elect to purchase its shares back, "National will proceed to sell" the stock in accordance with the provisions of the agreement and order of the CAB.

In his letter, Lewis detailed National's gains in the now defunct agreement. He said that the lease of Pan American's jet aircraft enabled National to provide jet service a full year ahead of its competitors and to be the first domestic carrier to offer such service.

He noted that the option to Pan American to purchase 250,000 additional shares of National stock was included in the agreement to compensate his company for the "advantageous lease to National and for the disparity in the values of the stock exchanged."

He said that a tentative CAB approval of the entire transaction permitted National to earn substantial profits with Pan American's jet aircraft during two winter seasons and added that the tentative approval also permitted the exchange of shares to be held by trustees pending final Board action.

CAB Order

Lewis wrote that, since the final CAB order disapproved the stock transaction and canceled Pan American's option, a plan cannot be developed which "would carry out the intent of the agreement the parties made or which would be equitable if National were permitted to sell the Pan American shares as it proposes."

He said that "what National is in effect proposing is that it be allowed to change the agreement . . . and take a further $4 million profit at the expense of Pan American's stockholders, in addition to the benefits already obtained."

Baker, unsympathetic with Pan American's case, said that Lewis' letter is "inaccurate in so many aspects that we deem it unnecessary to burden the Civil Aeronautics Board with a comprehensive discussion of all the unfounded statements and conclusions."

USAF Is Returning Moroccan UN Troops

Wiesbaden—U. S. Air Force aircraft are returning the more than 2,000 Moroccan troops in the Congo to their homeland on a "space available" basis following a Moroccan government decision to withdraw its forces in protest over the United Nations' role in the rebellious republic.

A spokesman at U. S. Air Forces in Europe headquarters here said last week that some 500 of the troops had been flown to Sidi Slimane Air Base near Rabat up to that time. Troop departures were scheduled on aircraft returning from the Congo after flying in supplies and troops to help fill the gap left by departing Moroccan and United Arab Republic units.

Lockheed C-130 turboprop transports of USAFE's 322nd Air Division also were used at United Nations' request to return 520 United Arab Republic troops and 101 tons of cargo to Cairo earlier this month, after the UAR decided to withdraw its forces from the UN Congo contingent.

Both Morocco and the UAR have been staunch backers of the regime of the late Patrice Lumumba and have been highly critical of the UN for its failure to lend all-out support to attempts to oust the government of President Joseph Kasavubu. The U. S. has generally supported President Kasavubu but agreed to UN requests for airlift to help in the removal of the dissident troops.

Earlier, to help fill the void being left by these departures, two Douglas C-124s of the Military Air Transport Service made the longest flight thus far in USAF's Congo airlift effort that began last summer when they ferried 130 Malayan troops and four tons of cargo the 6,000 mi. from Singapore to Leopoldville. With a refueling stop at Teheran and using double flight crews to avoid delays for crew rest, total elapsed time for the flight was approximately 50 hr.

The two aircraft made the 8,000-mi. outbound flight from Chauteauroux Air Base, France, to Singapore in about 60 hr.

Eastern, Mohawk Ask To Transfer Routes

Washington—Eastern Air Lines and Mohawk Airlines have asked the Civil Aeronautics Board to transfer service to two Vermont cities and six New York cities from Eastern's system to Mohawk's.

Mohawk would take over Eastern's operating authority between New York and Rutland and Burlington, Vt., and Albany, Glens Falls, Plattsburgh, Saranac Lake/Lake Placid, Massena and Watertown, N. Y.

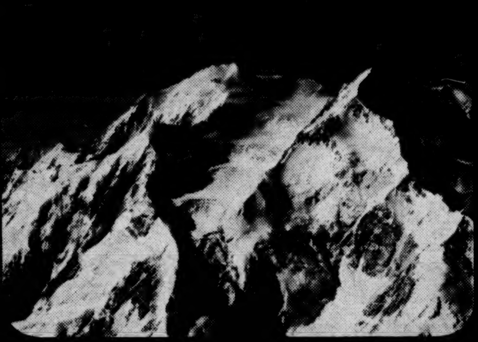
Eastern employes would be given the option of transferring to other stations on Eastern's system or accepting comparable employment, at no loss of pay, by Mohawk.

The proposal would put Mohawk in the New York to Albany route pattern, allowing the carrier to connect with its services from Boston, Syracuse, Buffalo, Detroit and Cleveland. Eastern would continue to serve Montreal and Ottawa non-stop from New York and to fly between Syracuse and the Canadian points.

Airline Traffic—Year, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor (%)
DOMESTIC TRUNK								
American	8,101,651	6,290,753	65.3	23,454,148	12,059,377	112,324,672	751,282,814	56.6
Braniff	2,232,946	1,066,355	56.9	5,135,800	1,978,074	7,476,352	116,806,691	46.6
Capital	3,588,638	1,497,121	53.0	6,511,819	3,474,432	5,621,139	159,082,244	48.7
Continental	1,336,794	891,239	50.3	2,362,040	1,420,494	5,127,410	94,326,615	40.5
Delta	3,358,907	1,840,228	59.3	5,875,517	3,680,696	15,465,982	201,943,915	49.9
Eastern	7,649,563	4,042,568	52.19	14,794,050	6,418,805	21,622,074	433,291,612	41.62
National	1,641,759	1,047,471	53.8	3,948,996	793,982	8,022,758	114,081,317	42.6
Northeast	1,439,438	566,370	51.6	1,552,003	489,645	2,657,844	58,908,544	45.0
Northwest	1,847,953	1,351,044	55.3	7,592,493	3,422,809	17,852,414	158,414,183	49.9
Trans World	4,967,334	4,486,968	63.9	19,266,684	9,087,768	43,803,021	502,054,502	52.6
United	7,575,894	5,388,850	64.8	36,545,288	11,415,746	77,142,909	642,067,239	56.6
Western	1,668,233	951,461	57.8	3,845,627	1,199,033	4,059,515	100,222,399	51.7
INTERNATIONAL								
American	111,182	114,303	59.3	120,318	9,441	2,859,837	14,793,953	58.6
Braniff	66,413	129,418	53.3	403,236	....	1,628,626	15,860,318	47.6
Caribbean Atlantic	387,077	27,210	63.8	26,076	....	94,236	2,832,289	66.1
Delta	27,610	38,306	42.2	57,148	....	327,848	4,584,216	40.4
Eastern	491,811	722,369	58.28	1,462,710	....	2,921,846	75,807,540	53.39
Mackey	128,176	26,699	47.5	....	2,513	58,218	2,887,185	47.6
National	32,652	26,439	52.5	28,044	10,262	108,056	3,001,841	47.8
Northwest	185,296	324,610	49.8	15,537,900	186,878	11,051,360	61,492,218	55.1
Pan American-Alaska	67,969	71,233	52.7	459,785	6,336	2,028,780	9,954,344	52.4
Atlantic	1,494,512	2,068,692	62.4	22,460,691	....	51,588,374	289,683,438	56.2
Latin America	1,182,652	1,419,449	66.0	5,397,647	....	50,373,274	196,179,936	63.1
Pacific	441,013	1,566,319	69.2	26,551,103	34,974	32,947,444	222,439,016	60.6
Panagra	124,594	198,327	57.4	1,009,237	....	6,685,857	29,187,278	57.8
Resort[1]	....	....	....	....	....	....	....	....
Trans Caribbean	139,865	216,058	81.0	....	....	4,553,081	23,128,955	81.6
Trans World	382,916	1,172,799	61.4	16,106,416	....	17,715,743	156,076,528	59.1
United	162,804	404,752	71.9	2,657,283	120,490	1,779,260	45,662,988	66.5
Western	53,386	83,020	64.0	106,962	....	292,203	9,093,277	66.8
LOCAL SERVICE								
Allegheny	670,111	131,657	42.5	204,581	358,015	523,035	13,654,552	44.0
Bonanza	261,876	65,155	40.1	99,205	41,087	125,180	6,497,954	41.2
Central	168,863	33,007	39.2	104,611	47,462	140,592	3,455,679	35.7
Frontier	338,189	90,028	38.8	332,482	120,674	754,026	9,886,325	43.1
Lake Central	226,936	35,974	38.5	71,279	222,956	....	3,735,434	42.1
Mohawk	590,162	119,409	45.5	218,066	215,596	224,699	12,006,220	42.4
North Central	967,210	171,732	43.56	493,328	542,708	508,773	18,206,271	44.86
Ozark	563,184	99,971	40.7	208,492	309,379	361,897	10,443,471	44.4
Pacific	499,395	114,180	50.5	196,837	53,891	106,908	11,307,252	45.7
Piedmont	457,123	97,048	45.3	166,610	170,399	238,473	9,880,178	46.7
Southern	256,947	46,765	31.7	179,054	126,409	162,298	4,953,317	33.6
Trans-Texas	306,885	72,035	38.7	265,128	150,918	476,155	7,783,120	40.1
West Coast	389,077	93,188	44.57	174,452	59,794	230,637	9,364,457	44.79
HAWAIIAN								
Aloha	359,826	54,139	59.8	34,503	....	86,404	4,431,638	52.6
Hawaiian	518,989	115,533	63.3	396,060	....	2,909,893	13,253,544	59.6
CARGO LINES								
AAXICO[2]	....	....	....	....	....	35,757,640	35,757,640	65.11
Aerovias Sud Americana	....	....	....	....	....	5,660,130	5,660,130	77.79
Flying Tiger	42,707	151,123	77.6	652,040	666,972	105,111,799	121,543,101	73.3
Riddle—Domestic	....	....	....	254,338	392,922	25,746,893	26,384,153	68.6
Overseas	1,251	4,899	96.1	75,123	45	5,943,341	6,508,440	64.5
Seaboard & Western	27,393	105,669	100.0	9,149,570	....	40,835,843	60,922,629	79.9
Slick	28,473	114,252	100.0	....	....	54,595,425	66,010,950	100.0
HELICOPTER LINES								
Chicago Helicopter	309,269	5,206	48.0	14,054	....	....	511,270	40.1
Los Angeles Airlines	39,184	1,360	55.8	58,414	28,344	....	216,808	64.4
New York Airways	146,775	3,017	53.4	19,295	12,034	6,881	326,238	52.8
ALASKA LINES								
Alaska Airlines	123,616	108,459	57.4	889,103	49,051	4,495,650	16,107,751	63.4
Alaska Coastal	60,430	6,070	54.8	50,518	....	63,649	732,980	58.8
Cordova	16,771	3,349	42.1	50,719	....	564,857	959,792	49.0
Ellis	60,509	3,702	52.7	27,944	....	33,825	438,750	62.5
Kodiak Airways[4]	537	213	39.04	430	....	470	3,129	37.60
Northern Consolidated	29,121	9,182	38.7	490,092	....	748,164	2,240,510	58.6
Pacific Northern	120,244	116,304	48.3	1,584,956	100,664	3,990,703	18,293,383	61.9
Reeve Aleutian	16,231	14,776	37.8	624,028	....	883,932	3,127,886	59.8
Western Alaska[5]	6,079	371	76.0	6,949	....	10,722	52,969	61.0
Wien Alaska	44,385	12,918	48.6	546,277	....	1,199,872	3,068,161	52.7
Avalon Air Transport[3]	59,935	2,536	55.4	3,671	....	4,214	248,898	57.2

[1] Ceased operations 7/1/60. [2] Ceased operations in July, 1960. Previous figures are charter operations only. [3] Since 6/24/60.
[4] Since 12/4/60. [5] Since 2/27/60. Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

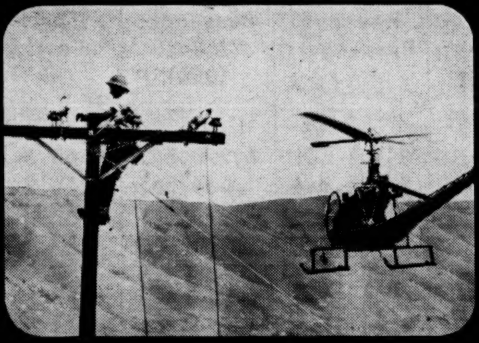


Hiller 12 E sets aviation record, lands and picks up payload at 18,000 ft.

12 E, first light copter to erect entire powerline; 40' poles, el. 5,000 ft.

34,500 lbs. of machinery to exploration mine in 8 hrs. mountain flying.

Microwave station on 4,000' ridge; all 8 tons material; 2 days flying.



2½ mile powerline built in 6 hrs., 50 mins. with E's 305 hp at work.

El. 10,000 ft. Two 12 E's fly 80 gal. sprayloads; 60 flights in 4 hrs.

You are invited to write for full details.

THE ARMY GROWS 'EM TOUGH

How the Hiller 12 E Became First Choice of Commercial Operators

From the day it went into commercial service, the Hiller 12 E had a head start. It had an Army-proved H-23D airframe and an Army-proved H-23D drive system that hadn't begun to exploit its full strength.

The next step rewrote the specs on what light utility helicopters can do. Capitalizing on the H-23D Raven's dynamic components with a 305 hp Lycoming engine's power, light helicopter "firsts" of the kind above were bound to happen. Similar profitable operations are flown every day, wherever there's an E.

That's why the 12 E has become first choice—it's the most economical helicopter purchase today.

Designs are one thing. Deliveries another. Both come from

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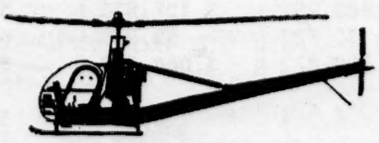
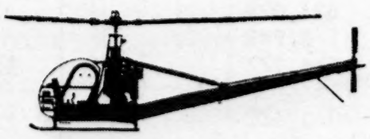
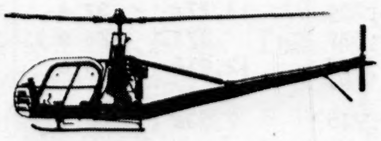


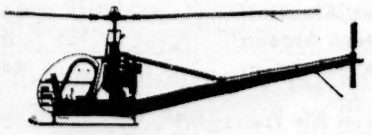
H-23D 250 hp



12 E 305 hp



E4 320 hp



Super E 340 hp

Three Trunks Report Lower Profits in 1960

Washington—Three trunklines last week reported record revenues for 1960, but a sharp rise in operating expenses forced net earnings to a level below profits reported the previous year.

American Airlines reported net earnings from operations of $10 million for the year, compared with $13.3 million for 1959.

In addition, American had profits from the sale of property and equipment totaling $1.7 million, compared with $7.7 million the previous year from property disposals.

Western Air Lines earned $2.4 million, including a $105,000 net gain from property disposal, for the year. In 1959, Western's earnings reached an all-time high of $5 million.

Western's operating revenues reached a new high of $69 million last year, compared with $63 million the year before.

However, the airline's expenses rose 21% during the year, including a 68% increase in depreciation charges, transitional costs and flying equipment rentals. Terrell C. Drinkwater, Western president, said that revenues were "affected by the Electra problem and the business recession."

Braniff Airways earned an estimated $1.3 million in the last eight months of 1960 to wipe out losses of $581,000 during the first four months and produce net earnings of $720,560 for the year.

The carrier's net profit in 1959 was $2.5 million.

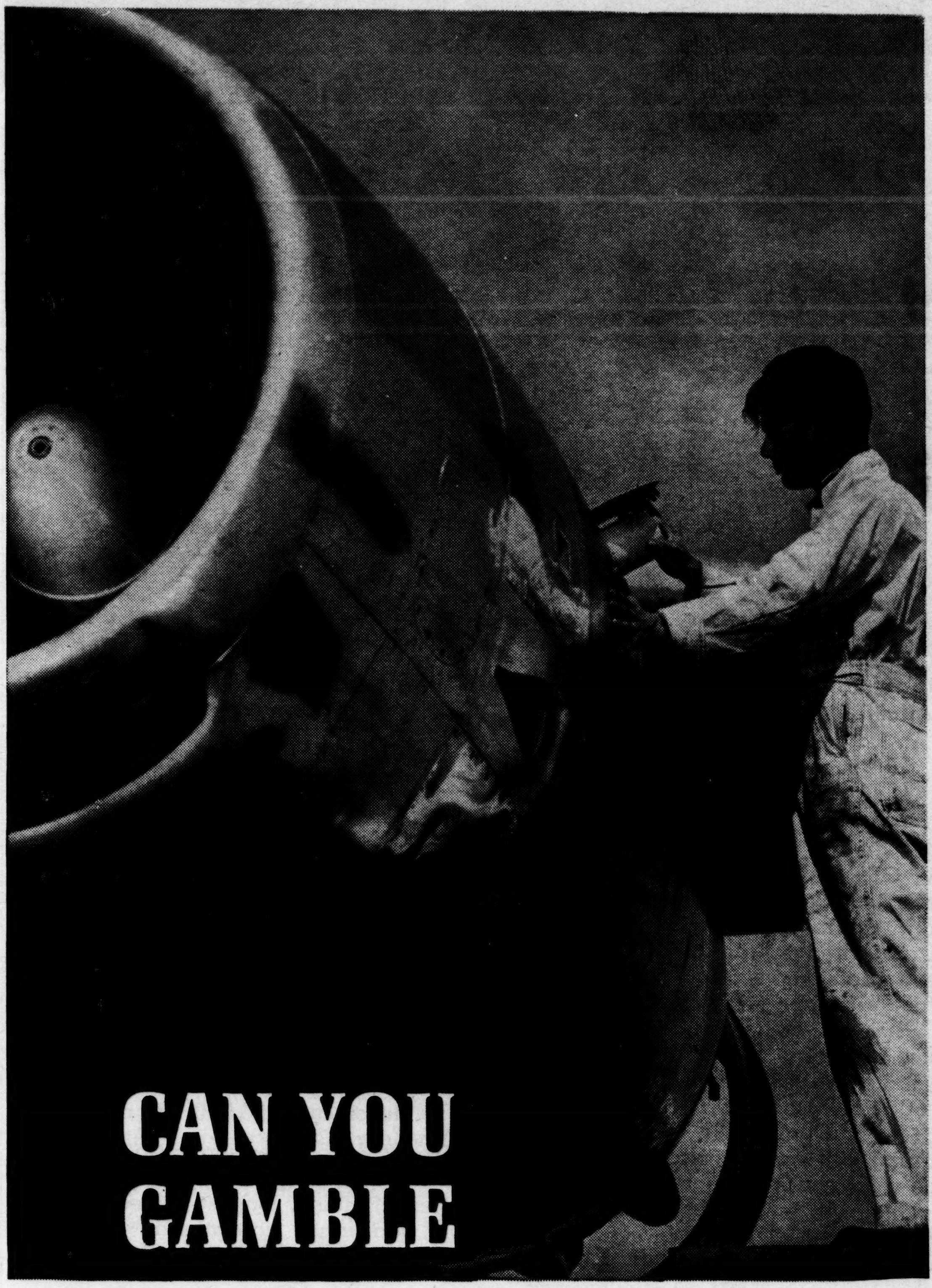
Braniff's revenues climbed from $74.2 million in 1959 to $86.5 million in 1960, a 16% increase. However, expenses rose from $69 million in 1959 to $83.9 million last year, an increase of 21%.

Commenting on the year's activities, Charles E. Beard, Braniff's president said:

"While costs increased across the board, one of the major items was the increased cost of operating our Lockheed Electras at restricted speeds." He said that operating costs were boosted by 26 cents per mile while the load factors dropped "precipitately." He added that the high Electra load factor of 61% attained in September did not meet the higher break-even need resulting from lower speeds.

In reporting on its year's activities, American made no comment on its experiences with the Lockheed Electra fleet but showed a total expense increase from $364 million in 1959 to $418 million last year.

Revenues for 1960 rose 13%, from $377.7 million in 1959 to a record $428 million.



on slim safety margins in low cost jet lubes?

Safety margins in synthetic jet lubes are being minimized by efforts to achieve lowest possible cost. This is not so when formulations are based on the Emolein® Azelates. These proven diesters provide the comfortable safety margins desired by engine manufacturers and commercial airlines.

Because diesters are such a major component in compounded lubricants, the use of azelates reflects directly in improved performance in terms of rubber swell, flash point, volatility, additive response, load carrying capacity and temperature-viscosity behavior.

Be sure that your jet lubes have the margin of safety provided by the Emolein Azelates. It is the *safe* way to save.

New Technical Bulletin 409B describing azelate-based jet lubes is available by writing Dept. Z-2A.

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Flight Propulsion

Left to right: Lt. Col. T. H. Miller, USMC; Vice Admiral W. F. Raborn, Jr., USN; J. D. Wethe, General Electric; Cmdr. J. F. Davis, USN; D. D. Clark, McDonnell Aircraft.

G. E. trophy goes to F4H pilots

NEW ORLEANS, La.—The General Electric trophy for significant achievement in military aviation in 1960 has been presented to the U.S. Navy and the two pilots who set new world speed records with the Navy's McDonnell F4H Phantom II fighter.

Joint recipients of the award are Lt. Col. T. H. Miller, USMC, who set a new 500-km record of 1216 mph; and Cmdr. J. F. Davis, USN, who set the 1390-mph 100-km run record.

The trophy was presented Jan. 13 at a regional Navy League meeting. In making the award, J. D. Wethe, an executive of G.E.'s Large Jet Engine Department, cited "the outstanding capability of the Naval air arm and the pilots who fly the Navy's jets."

The F4H in which Lt. Col. Miller and Cmdr. Davis set the closed-course records was powered by twin G-E J79-2 test engines. The Phantom II is now flying with the J79-8, an improved production engine. The more powerful -8 produces over 16,000 lbs of thrust.

Its 12:1 compression ratio helps to make the F4H the Navy's fastest, highest-climbing, longest-ranged fighter. *For additional information on the F4H/J79, check GED-4106. See coupon.*

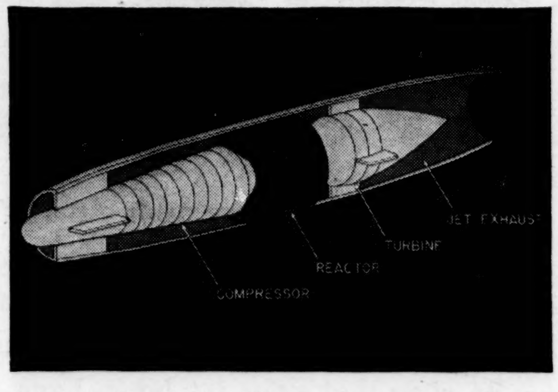
GENERAL ELECTRIC BEGINS WORK ON FLIGHT-TEST NUCLEAR ENGINE

EVENDALE, O.—A high-performance direct-air cycle turbojet powerplant scheduled for flight testing in the mid-1960's is now under development at General Electric's Aircraft Nuclear Propulsion Department.

ANPD General Manager David F. Shaw announced the program recently, after two modified turbojet engines were successfully started and brought up to normal operating performance on nuclear power alone.

In previous tests, startup was accomplished with chemical fuel. The all-nuclear start established the feasibility of the direct-air-cycle nuclear turbojet, using nuclear fuel for the entire operation.

With the all-nuclear start, General Electric completed a series of Heat Transfer Reactor Experiments (HTRE) conducted during the past five years. The HTRE series demonstrated the practicability of the direct-air cycle system and resulted in the development of many of the components necessary for nuclear flight.



Schematic of a nuclear powerplant shows how a nuclear reactor could replace the combustion system of the familiar petroleum-burning jet engine.

General Electric is developing an advanced flight-test direct-air-cycle turobjet under contract to the U.S. Air Force and Atomic Energy Commission.

". . . It is no longer a question of can we build a nuclear-powered aircraft propulsion system, but when can we place such a system in an aircraft," Mr. Shaw said. "We have reached the point where we can say that when an airframe is ready, we can have a nuclear direct-air-cycle engine ready to install in it."

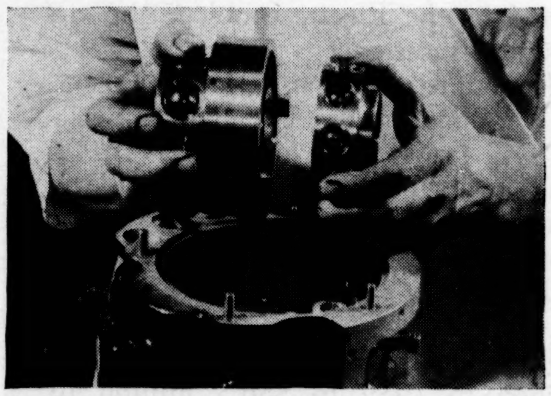
For more details on aircraft nuclear propulsion advances, check GEA-7105. See coupon.

F4H Features Unique Hydraulic Constant Speed Drive System

LYNN, Mass.—A unique G-E hydraulic constant speed drive powered the electrical system for the McDonnell F4H Phantom II during its record speed runs.

Two parallel 20-kva drives transform the variable speed of the twin J79 powerplants to the constant speed required by the aircraft's a-c generators. The drives, which can "lock" together to divide load, maintain system frequency constant within ± one-tenth of a percent.

The G-E drive is a compact radial-piston hydrostatic transmission that features free spherical pistons rather than conventional restrained cylindrical pistons, connecting rods, and associated bearings. The simple design concept has demonstrated reliability of .9997 per hour in over half a million operating hours in other aircraft applications.



Small ball piston elements, key transmission components of the hydraulic system.

The General Electric F4H electrical system contains several innovations for U.S. Navy "production" aircraft, including:

- First application of an integrated drive-generator package.
- First application of oil-cooled generators to provide environment-free conditions.
- First "high temperature" drive, operating continuously at 300F.

For more information about constant speed drives, check GEA-6890. See coupon.

NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

CONVAIR 990 LOGS FIRST FLIGHT

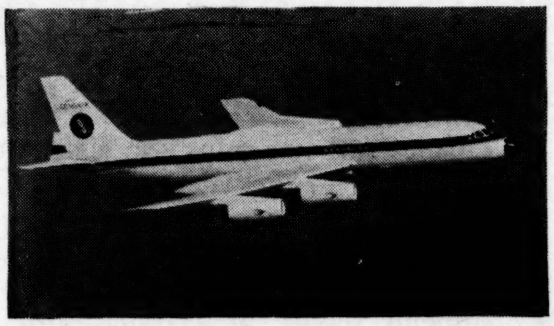
SAN DIEGO, Calif.—The first flight of a second generation jet airliner, Convair's 990 Coronado, was logged here on January 24 as the swift aft-fan transport climbed aloft on a 2-hour, 3-minute maiden flight.

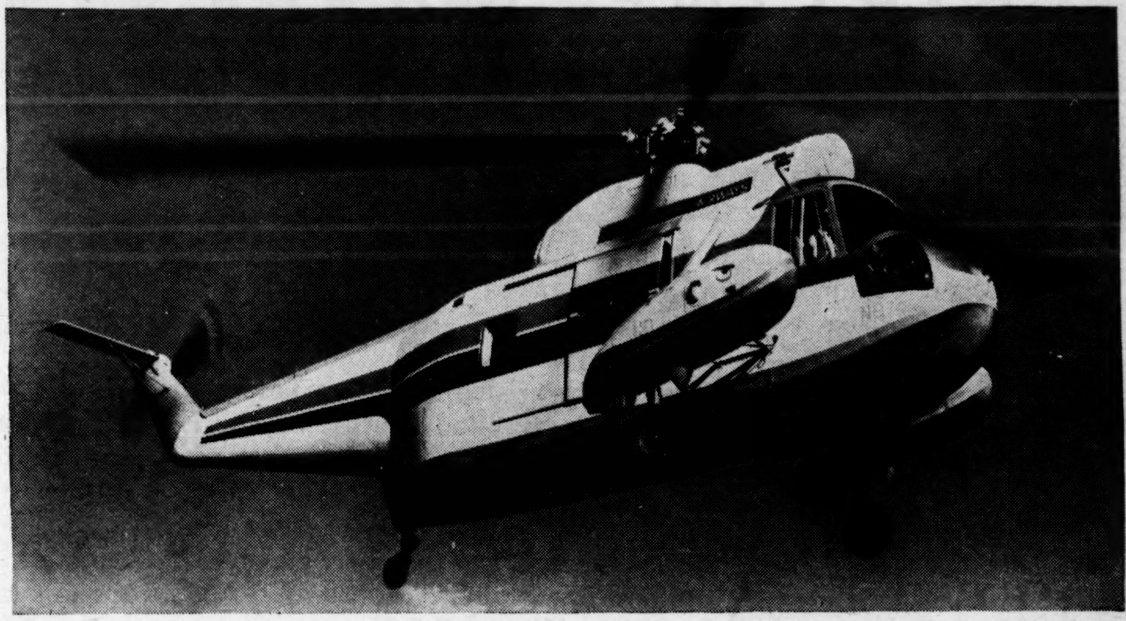
Powered by four 16,100 thrust-class General Electric CJ-805-23 aft-fan engines, the 990 flew at speeds up to 500 mph and altitudes to 25,000 feet.

A medium/long range jet capable of operating from 5000-foot runways, the 990 is designed to carry 96-121 passengers. Cruising at 640 mph, it will be the world's fastest airliner, and is expected to cut transcontinental non-stop flight time by as much as forty-five minutes.

The aircraft is scheduled to enter commercial service in mid-1961. In addition to speed and short-runway advantages, 990/CJ-805-23 operators will benefit from improved specific fuel consumption and quieter engine operation.

For more information on the Convair 990/CJ-805-23 check GED-4284. See coupon.





A single CT58 powers the Sikorsky S-62, with 10 passengers aboard, at 100 mph. S-62 will soon be in service for San Francisco-Oakland Helicopter Airline.

Second California Airline to Offer Turbocopter Service

SAN FRANCISCO, Calif.—San Francisco-Oakland Helicopter Airline recently announced plans to inaugurate Sikorsky S-62 turbocopter passenger service in the Bay area April 1, 1961.

Both the new airline and the Los Angeles Airways will be offering CT58 turbine-powered passenger service. The S-62 has serviced communities in the Los Angeles area since December. The new turbocopter has demonstrated its speed by flying 10 passengers from the Los Angeles airport to Azusa in 15 minutes—a distance usually requiring a 1-hour-and-40-minute drive.

M. F. Bagan, president of the San Francisco-Oakland line, said, "The excellent power-weight ratio of the CT58 engine and the proven components of this aircraft make the S-62 the most dependable helicopter ever built." Community spokesmen also commented that "its turbine engine makes it a very quiet aircraft."

Producing 1050 horsepower and weighing only 280 lbs, the economical CT58 weighs only 33% as much as reciprocating engines of the same rating. Fifty-five inches long, it requires only 25% of the space of similarly rated conventional powerplants.

Los Angeles Airways, New York Airways, and Chicago Helicopter Airways will fly turbocopters with twin CT58 powerplants in 1961.

For more S-62/CT58 information, check GED-3987A and GED-4236. See coupon.

G-E lift fan completes 90 hours' operation

EVENDALE, O.—General Electric recently logged another important step in its lift fan flight test program, completing 90 hours of operation. Fifty hours of wind tunnel testing were included in the operation.

The lift fan will permit tactical military or commercial aircraft to take off or land vertically, yet cruise as present jets do. A lift fan-powered aircraft flight test is planned for 1963.

During the recent program, the G-E lift fan engine system, powered by the 2450 pound thrust-class J85-7 engine, was mounted in a wind tunnel aircraft mock-up.

General Electric engineers have discovered that the lift of the airplane/lift-fan combination is greater than the lift of either of them measured separately.

This additional "interaction" lift is attributed to the fan pulling air through from above, creating a force on top of the wing to give the vehicle this lift bonus. Interaction lift helps assure flight over varying flight conditions.

G-E lift fan is designed for horizontal mounting in the fuselage or wings of VTOL aircraft. It is shown here in vertical position, during plant inspection.

FOR MORE INFORMATION

General Electric Company
Section A206-22
Schenectady 5, N. Y.

- ☐ GEA-6890 "Constant Speed Drives"
- ☐ GEA-7105 "Advances in Nuclear Aircraft Propulsion"
- ☐ GED-3987A & GED-4236 "CT58"
- ☐ GED-4106 "F4H/J79"
- ☐ GED-4284 "CJ-805 Progress Report"
- ☐ GER-1704 "F4H AC Electrical System"

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▶ Kennedy Administration is showing active interest in Civil Aeronautics Board's recent launching of an investigation to determine whether foreign flag carriers should be required to provide U. S. with traffic and schedule information (AW Jan. 30, p. 48). Protests against the move by foreign governments have raised the issue to White House level. Indications are that the Administration will take the position that Board orders involving foreign relations should be coordinated with the White House before any action is taken.

▶ Trunkline traffic continued to drop sharply during January, the third consecutive month of declining business. Bad weather on the East Coast during the first weeks of February and the flight engineers' wildcat strike are accelerating the steady drop in revenue passenger miles. In January, the domestic trunk carriers flew 2.34 billion revenue passenger miles, a 2.6% decrease from the volume generated the previous January. Available seat miles were held to 4.1 billion for a slight increase of 1.6% over January, 1960. Load factor for the 12 trunklines fell 2.51 points last month to 57%. Except for April, 1960, load factor has shown a decline in each of the last 16 months.

▶ Impact of the flight engineers' strike dampened recently growing interest in airline common stocks listed on the New York Stock Exchange, including shares of United Air Lines, which was unaffected by the walkout. Late last week, most airline stocks had declined slightly in a light turnover.

▶ Mixed coach and first-class configurations of turbojet transports continue to be adjusted as the demand for coach seats increases. During heavy tourist season on North Atlantic routes, the number of first-class seats available will be held to a minimum. TWA, for example, will remove two rows of first-class seats on its Boeing 707-331 turbojet transports and add three rows of economy seats. Configuration will be changed from 102 economy and 28 first-class to 120 economy and 20 first-class, a net gain of 10 seats.

▶ Seaboard & Western Airlines' board of directors has voted to change the carrier's corporate name to Seaboard World Airlines, Inc. Resolution will be submitted for approval of stockholders at the annual meeting Apr. 25.

▶ Aeroflot is continuing to introduce its An-10A turboprop transports into scheduled service. Latest flight schedule of the 100-passenger aircraft is on the 950-mi. route between Moscow and Krasnodar in the northern Caucasus, which is covered in 2.5 hr. on a daily schedule. The An-10A also is being operated on scheduled flights to Norilsk, above the Arctic Circle in Siberia (AW Feb. 13, p. 52), to test effectiveness of the aircraft's improved anti-icing system in scheduled operations under the most severe low-temperature conditions.

▶ British European Airways has strengthened its position in the eastern Mediterranean area by a recent signing of a management agreement with Cyprus Airways. BEA feels this move, along with an existing cooperative and equipment-sharing agreement with Olympic Airways of Greece, has advanced its competitive position in the area.

▶ Federal Aviation Agency will distribute a booklet to 5,000 airport managers and owners outlining preventive measures that can be taken against aircraft hazards caused by birds on the ground and in the air. The report was prepared under contract to FAA by Sport Fisheries and Wildlife Bureau of the Department of Interior.

▶ Civil Aeronautics Board decision last week, ordering Eastern Air Lines to drop advertising use of the DC-8B designation for its Douglas DC-8 turbojet transports in response to a Delta Air Lines complaint, may have far-reaching effects on other airline advertising programs. Most carriers can be expected to use colorful names to distinguish their aircraft fleets from those of the same model operated by competitors. Latest samples of such advertising approaches are American's use of "Astrojet" to identify its turbofan-powered fleet and TWA's general use of the word "Superjet."

SHORTLINES

▶ **British Overseas Airways Corp.** plans to start twice weekly Boeing 707 Intercontinental service Apr. 11 from London to Lima, Peru, via New York and Nassau. Bahama Airways, a BOAC associate, will reschedule its Miami-Nassau service to connect with the new Lima flights.

▶ **Flying Tiger Line**, Seaboard & Western Airlines and Slick Airways Canadair CL-44 turboprop transport airframe overhaul cycle has been set initially at 13,500 hr. by the Federal Aviation Agency. The cycle is based on a continuous maintenance program.

▶ **Iberia Air Lines** of Spain will introduce Douglas DC-8 turbojet transports on its Atlantic routes June 1. The carrier initially will offer three non-stop flights from New York to Madrid and one weekly non-stop flight from New York to Lisbon, which will continue to Madrid. Iberia's DC-8s will seat 120 passengers in mixed first and economy classes.

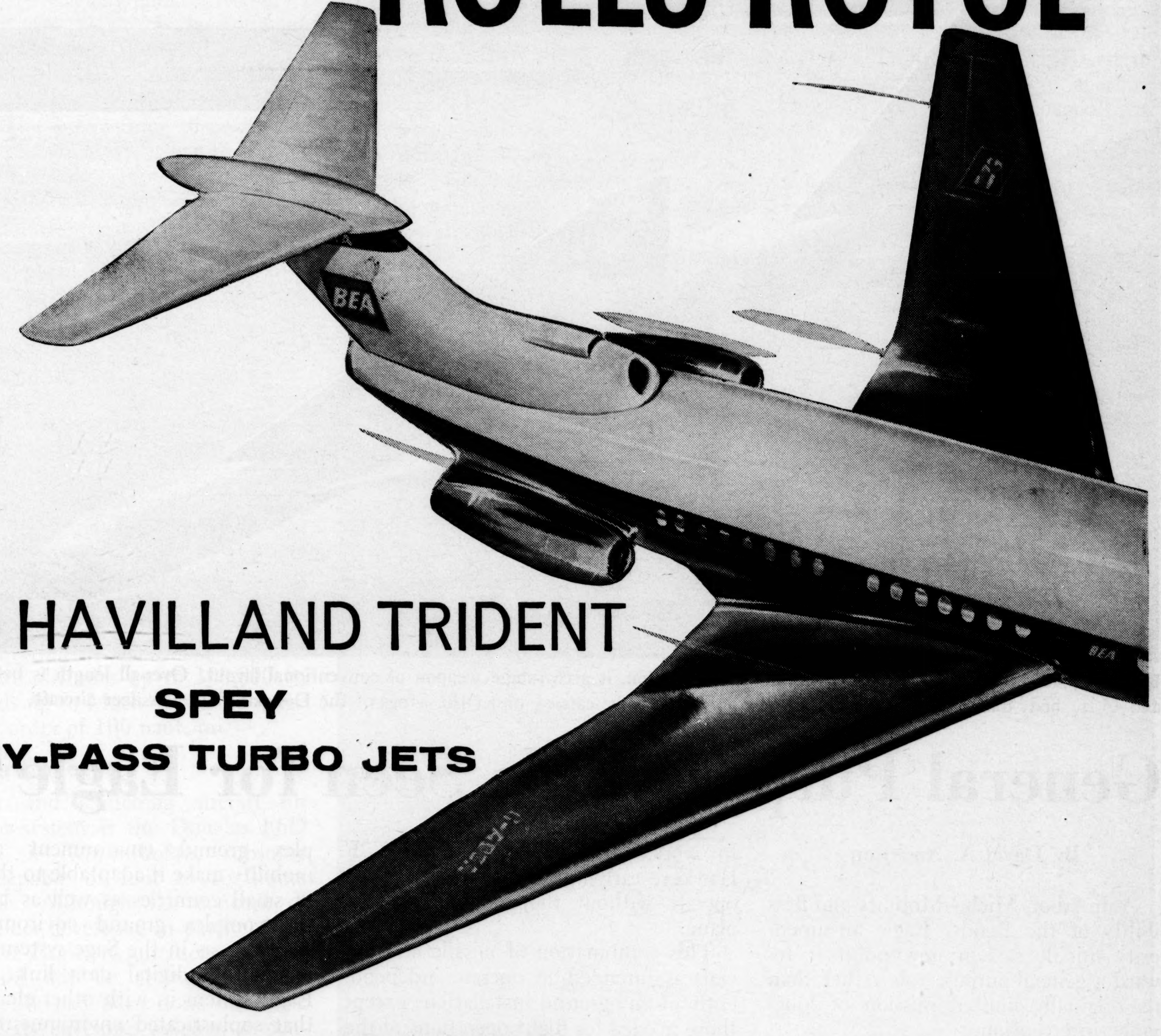
▶ **Northwest Airlines** has resumed service between Chicago and Minneapolis/St. Paul via O'Hare International Airport with three daily Electra flights, providing the first service to Chicago since the carrier's domestic flights were grounded by labor troubles which began Jan. 9. Electra flights will connect at Minneapolis/St. Paul with Douglas DC-8C turbojet transport flights from New York to the West Coast.

▶ **National Airlines** has asked the Civil Aeronautics Board for permission to suspend service at Havana until the economic and political situation there becomes more stable.

▶ **Qantas Empire Airways** will resume a sixth weekly Boeing 707 turbojet flight from Sydney to San Francisco Mar. 2. Of the six weekly flights, two continue on to New York and London and one continues to Vancouver. All Qantas transpacific flights stop at Honolulu and Nadi, Fiji.

▶ **United Air Lines** has ordered 51 RCA air traffic control transponders for use in Douglas-built Sud Aviation Caravelle turbojet transports, which are to enter service this summer, and Boeing 720 turbojet transports, due for delivery in 1962. United plans to add an altitude reporting capability to the transponders as soon as FAA provides the necessary ground facilities. All of United's present turbojet transports are equipped with transponders.

POWERED BY ROLLS-ROYCE



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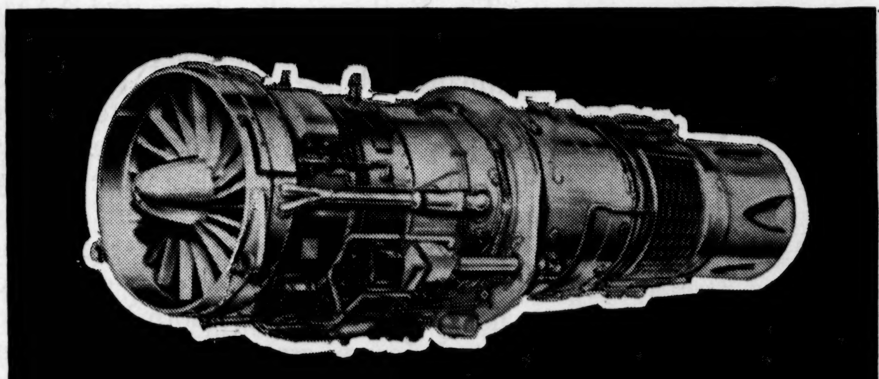

The Spey by-pass jet has been specifically designed to give the best possible operating economics for the second generation of short to medium range jet transports.

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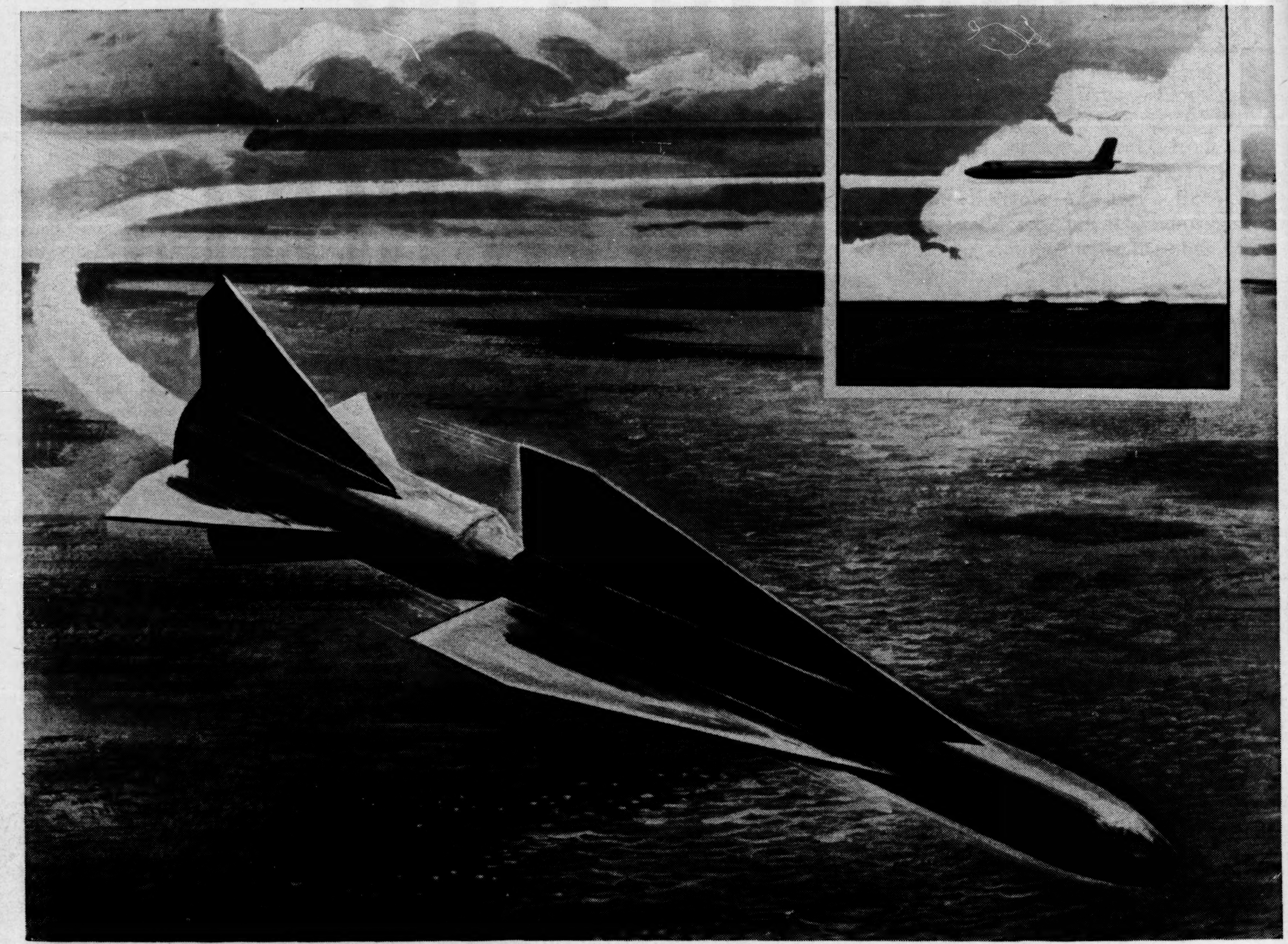


BENDIX EAGLE MISSILE, shown here in artist's conception, is a two-stage weapon of conventional layout. Over-all length is between 12 and 15 ft., body diameter is 14 in. Six of these missiles will be carried under the wings of the Douglas F6D Missileer aircraft.

General Purpose Role Seen for Eagle

By David A. Anderton

Ann Arbor, Mich.—Mobility and flexibility of the Bendix Eagle air-superiority missile system now point it toward a general-purpose role rather than its originally limited mission of long-range interception.

The Eagle system has been designed to protect a fleet task force, envelop a beachhead, deny an inland area to enemy air, or support an air drop of troops or supplies. Its possible use in attack and anti-submarine warfare missions is being studied as a further extension of its capabilities (AW Feb. 13, p. 23).

Eagle system development is currently in the prototype phase, under a multi-million-dollar prime contract held by Bendix Systems Division here. It was planned as a high-performance, long-range missile to be carried by a subsonic, long-endurance airplane dubbed Missileer. Eagle system was designed to work with the Grumman W2F Hawkeye early-warning aircraft, but can operate without the input from that plane.

This combination of missile and aircraft is intended to operate independently of any ground installations except those needed for flight operations of the planes. The system will operate in either a carrier or land environment, and has its own electronic countermeasures capability.

Original Plans

The Eagle system originally was intended to solve the problems of defense of a modern naval task force, spread out over hundreds of square miles of water. But its capabilities interested the U. S. Marine Corps, whose planners now see the Eagle as support for their concept of vertical envelopment. Proponents of the system say that it also is one solution to the tactical problems of brushfire wars; its independence from a complex ground environment and its mobility make it adaptable to the forces of small countries as well as large. If the complex ground environment is available—as in the Sage system—then a compatible digital data link ties the Eagle system in with other elements in that sophisticated environment.

The Eagle missile, designated AAM-N-10 by the Navy, is a two-stage weapon estimated at 12- to 15-ft. long, and weighing about 1,300 lb. Body diameter is 14 in. Warhead weight approximates 100 lb., enough to handle a wide variety of charges.

Geometry is conventional; the cylindrical body has an ogival nose cone and a flared-skirt afterbody. Both lifting and control forces are generated by four highly swept, truncated delta surfaces reminiscent of the Hawk planform. A finned booster completes the layout.

Airframe of the Eagle missile is being designed and built by Grumman Aircraft Engineering Corp. under subcontract to Bendix Systems Division. Grumman's work, currently funded at about $8.4 million, includes building the Missileer wing launching racks for the Eagle and the ground handling equipment.

The two-stage solid-propellant propulsion system is being developed by Aerojet-General Corp. under an $8-million subcontract to Grumman. Rocket motor cases are being fabricated by Solar Aircraft Co. as Aerojet subcontractor.

Complete Eagle guidance system is split into several major development contracts. Westinghouse Air Arm Division is building the airborne radar in both the Missileer airplane and Eagle missile. The input from those radars, plus other information, is handled by an airborne tactical computer being developed by Litton Systems, Inc.

Initial and mid-course guidance is the responsibility of Bendix Research Laboratories Division. Terminal guidance is a Sanders Associates, Inc., development, believed to be a coherent pulse-Doppler radar type with extremely high target resolution.

Some of the subsystems are being designed by Bendix Pacific Division, where missile production, assembly and test responsibility will also be centered. Eagle's auxiliary power unit will be built by AiResearch Manufacturing Co. Human factors consultants will be Dunlap & Associates.

One indication of performance is given by the requirements for test range instrumentation which will be required to measure altitudes up to 100,000 ft. and speeds up to Mach 4. Missile range is on the order of 100 naut. mi.

Missileer Concept

Carrier and launching aircraft for the Eagle system is the Douglas F6D Missileer, a twin-turbofan, subsonic aircraft capable of four to six hours endurance. Although the concept of the Missileer developed in parallel with that of the Eagle, requirements for the type could not be crystallized until enough work had been done on Eagle to define its envelope weights, dimensions and environment.

For this reason, Missileer proposals were not requested by the Navy until 1959, with a due date for submission of designs of Feb. 29, 1960. Six companies bid on the Navy's Airborne Weapon System 404: Boeing-Wichita, Chance Vought, Douglas, Grumman, McDonnell and North American. Douglas was chosen by the Navy's evaluation group and the company started design of the mother aircraft.

Missileer is built around a three-man crew: pilot, copilot, and missile control operator. The missileman works in his own environment, in a parallel role with that of the sonar operator in an ASW helicopter. The task of the operators in both cases is almost completely divorced from any phase of airplane operation. Their job is to control the missile.

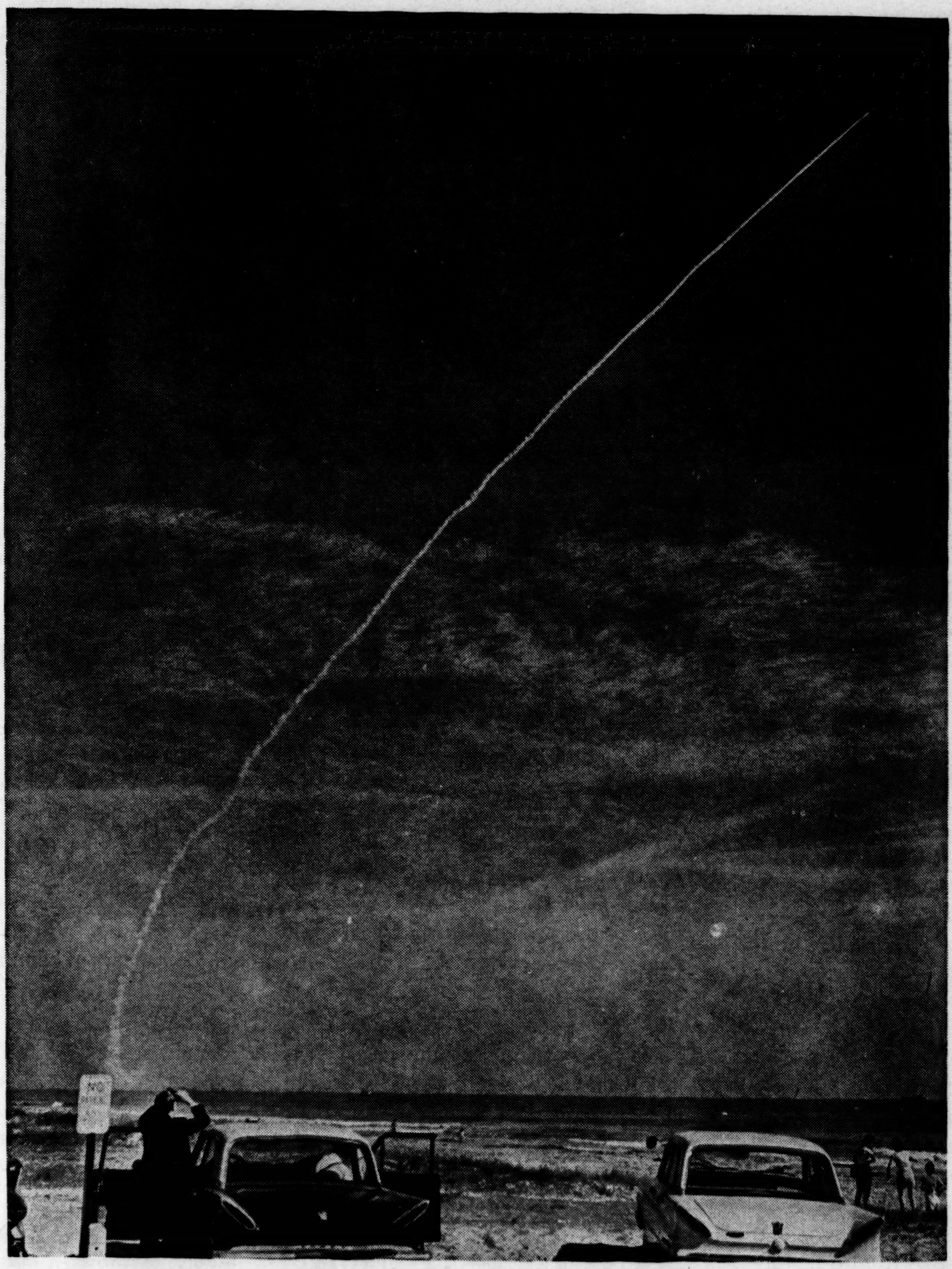
One indication of the independence of the missileman from airplane problems is in the assignment of engineering responsibility for human factors work on the operator and his environment. In the Missileer aircraft, such work is part of Bendix Systems' task; Douglas, although designer of the aircraft, is only responsible for human factors in the pilot environment.

Douglas Missileer is a conventional airframe powered by a pair of Pratt & Whitney TF30-P-2 turbofan engines rated at about 10,000 lb. thrust each. Top speed is subsonic, estimated at Mach 0.9. It is designed to cruise for four to six hours at most economical speed, carrying a primary armament of six Eagle missiles.

Current status of the Missileer program is an active one, even though procurement funds have been cut from this fiscal year's budget (AW Feb. 13, p. 32). Donald W. Douglas, Jr., said recently that he was optimistic about restoration of production funds for the airplane, which was well into the development phase.

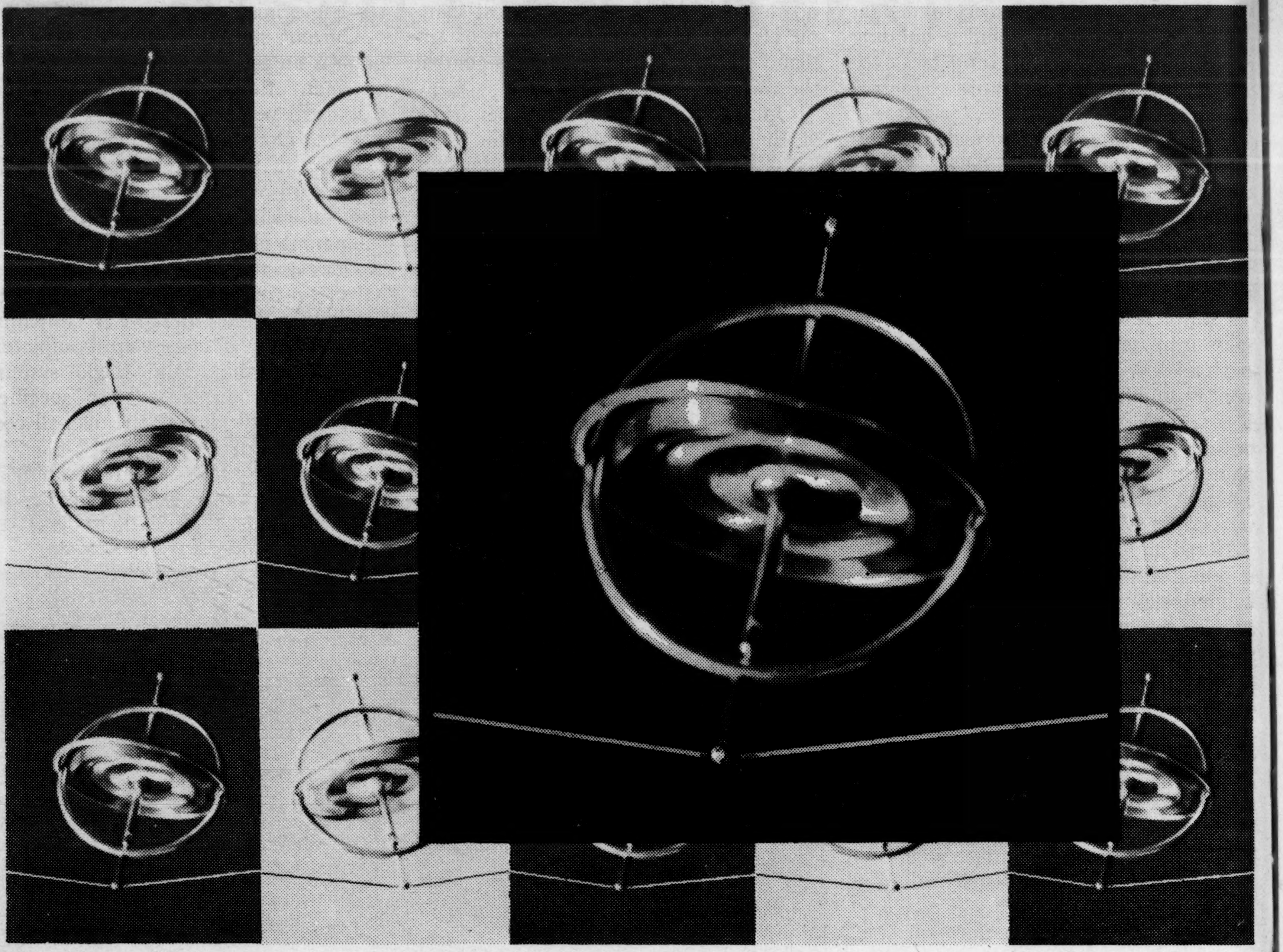
Douglas and other companies in the Missileer competition submitted both new and modified designs as launching aircraft. New designs were completely optimized around the Eagle system; the modified airplanes were specified as one way of reducing the over-all cost of the program.

Navy has bailed three Douglas A3D twin-turbojet aircraft to Bendix for development and flight test of



Autonetics Guidance Programs Minuteman

Smoke trail of Minuteman, launched from Cape Canaveral Feb. 1 (AW Feb. 6, p. 28), shows Autonetics guidance and control system starting to program the missile, about 3 sec. after launch, at approximately 300 ft. altitude to an angle of about 20 deg.



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Eagle system components. These planes, although unnecessarily large for the Missileer job, could be modified to be the launching aircraft if the Navy were not able to afford Missileer as a separate aircraft procurement program.

Bendix so far has received three contracts approximating $50 million. First was the initial research and development funding, an unspecified amount. Second contract was awarded last April for $21 million, and the third followed last November in the amount of $26 million. Out of these sums come funds for the subcontractors, such as the $8.4 million to Grumman for the airframe.

One indication of the amount of avionics involved is a Navy estimate that the final cost of the program will be about 75% chargeable to guidance and control, 10% to powerplant, and 15% to airframe.

Missileer funds are separate from the Eagle budget; no production funds have yet been earmarked for the plane, but it has been financed well along into the development stage.

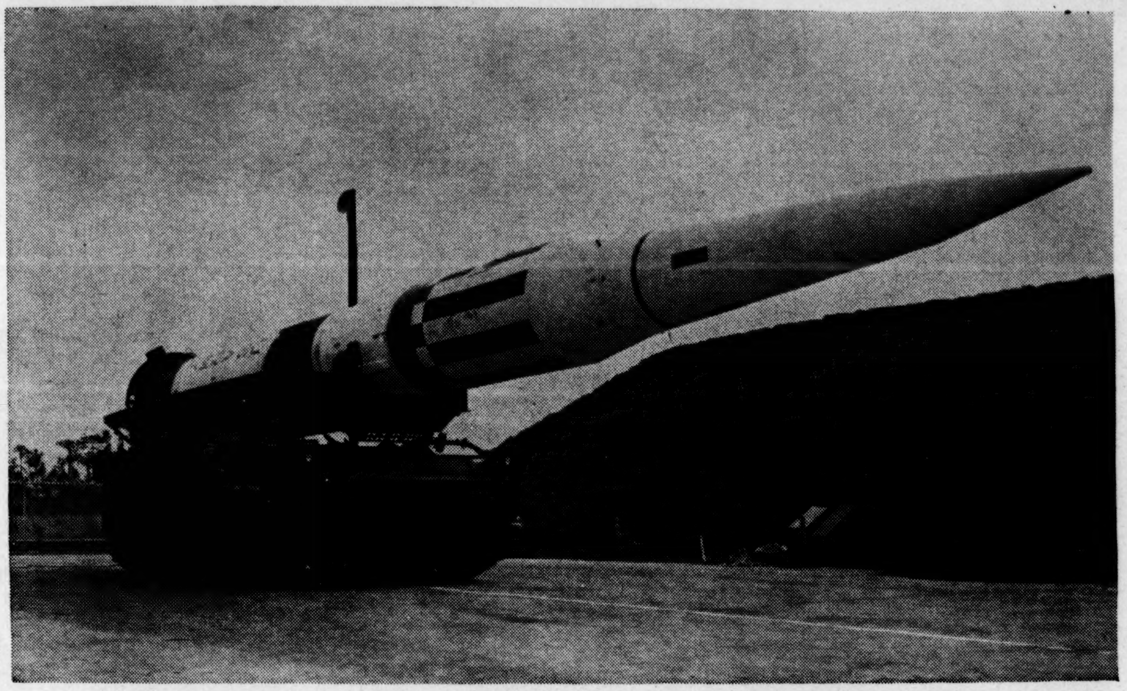
Eagle Evolution

Studies of the increasing complexity of intercept problems in the 1950s showed that higher speeds of aircraft were imposing tougher requirements on the design of the remainder of the intercept system. Reduced frontal area of airplanes, one prerequisite for increased performance, meant that radar dish sizes were arbitrarily reduced. Closing speed between interceptor and target gave a pilot less time to complete closing the loop in the fire-control systems then available.

In 1953, these worries had become so overriding that the Navy started a series of formal studies of the interception problem and the ways it could be solved. These studies were the genesis of the Eagle concept.

Bell Telephone Laboratories, acting then as consultants to the Navy's Bureau of Aeronautics, suggested the approach. Build all the performance into the missile, Bell engineers said, and most of the detection and control into the launching aircraft. That way one could build an airborne launching site, with an array of avionic systems for detection and identification of target, prediction of target flight paths, launching at optimum times, initial and mid-course guidance, and ECM capability among other things. The launching site could be carried in a slow-flying airplane built for comfort and not for speed.

Navy picked up the concept and developed it further with its own study program at various installations during the next two years; the more Navy studied the problem, the better the Eagle idea looked. There was initial opposition from some naval pilots, who came out with strong negative opinions on the whole idea of automated intercepts. On the other side of the argument was a solid front of the Navy's missile-systems officers and engineers, and eventually their weight carried the issue.



Pershing Missile With Group II Nose Cone

Army-Martin Pershing tactical field missile is shown with its Group II nose cone used in the last six launches (AW Jan. 2, p. 13). Pershing has had nine completely successful test flights in 11 day and night launching attempts. The 34-ft. missile is on the Tapco Group transporter-erector-launcher carried on an XM-474 tracked vehicle.

There was concern in the early stages of the Eagle idea that it would duplicate the U. S. Air Force's F-108 long-range interceptor project, then in design at North American Aviation. An evaluation of both projects by a neutral committee headed by National Advisory Committee for Aeronautics' John Stack concluded there was no duplication of effort, and that Eagle was justified as a separate development.

Final operational characteristics were roughed out by the Navy for a 1958 design competition, which specified that a complete systems design be submitted, not just a proposal with details to be worked out later. There was only one requirement externally imposed on the Eagle system, other than the usual Navy limitations specified by carrier operations: Eagle was to be compatible with input data from the Grumman W2F Hawkeye early-warning aircraft.

Many contractors had anticipated the Navy's request for system designs with in-house studies of the problem. Collaboration among companies had already been recognized as one way to meet the requirements, and several teams were working closely when the competition began.

Final system proposals were submitted by Chance Vought, Douglas, General Electric, North American, United Aircraft and two teams: Sperry/RCA/Convair and Bendix/Grumman, among others. Bendix/Grumman team was chosen on the basis of its proposal, although the team had not submitted the low bid.

Navy specified that PERT management technique (AW Nov. 28, p. 85) would be used beginning with the initial design phase of the Eagle system. This early application was in contrast to the Polaris program, where PERT was begun only after there was substantial production of hardware. In turn, Bendix is using PERT on a systems basis with its subcontractors in the Eagle program.

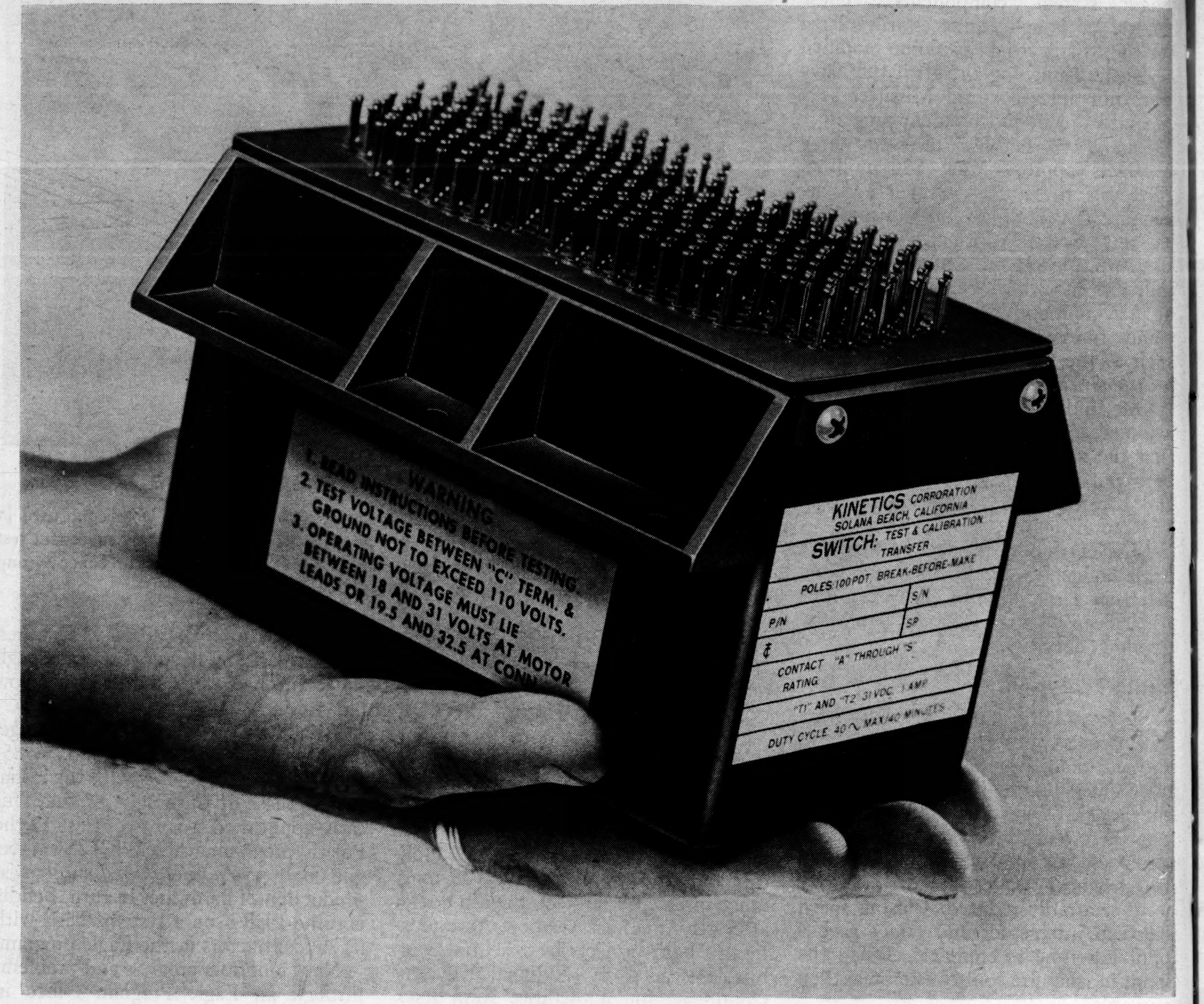
Navy monitors progress and problems through an Eagle Program Office in Bureau of Naval Weapons (BuWeps); the office is a small group with over-all responsibilities for technical direction of the system development.

Major Effort

One major effort on Eagle is going into a cost-reduction program which begins at the top level in Bendix Systems Division and extends out through all phases of the program work at subcontractor levels. Value engineering and value analysis techniques are used to monitor running development costs; subcontractors are expected to use similar approaches to keep their costs down.

Every six months, Bendix engineers review subcontractors' specifications, looking for places to reduce costs. Requirements are scrutinized to determine whether they are realistic. Reports are questioned, also, because one way to cut the cost of any development program is to reduce the amount of written reporting generally demanded at every working and managing level.

Test facilities is another area where cost savings have been made. The ten-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The Kinetics switch is motor-driven for maximum reliability. There are no permanent magnets or springs, no latching devices, no other relay elements of any kind to cause trouble. The switch can be transferred at 40 G's, 2000 cycles. Once it's transferred, no power is required to hold it in position, saving batteries. The switch exhibits no contact chatter over the whole vibration spectrum, from 5 to 2000 cycles, 40 G's. Voltage drop across contacts is less than 10 millivolts at 15 amps.

This new Kinetics switch lends itself to many space craft and missile applications. Instrumentation; a-c and d-c power, destruct circuits and others may all be accommodated in one switch. A typical application would be the transfer of guidance, telemetry and control signals from one stage to another in a multi-stage missile.

Kinetics' switches are used on the major missile and space craft programs where maximum reliability under rigorous environmental conditions is essential. For help with your switch requirements, write or phone Kinetics Corporation, Dept. KA-2, 410 S. Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

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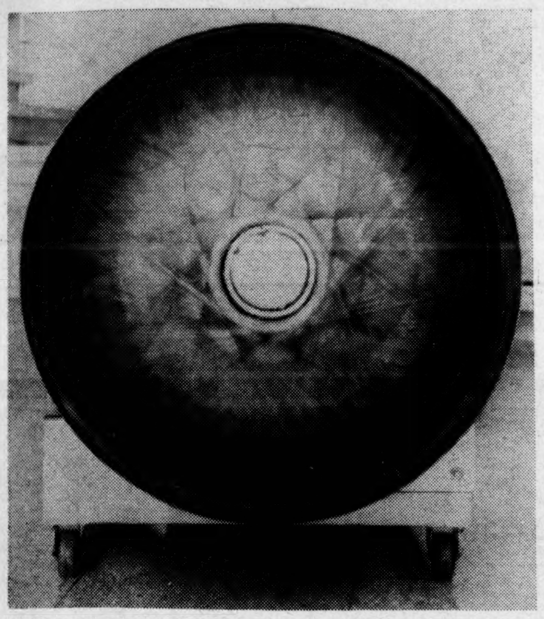

Hercules Casing

Casing for the USAF-Hercules third stage for Minuteman is produced by winding glass fibers to reinforce the resin plastic case. Lightweight Spiralloy case is made at Hercules Powder Co.'s Rocky Hill, N. J. plant.

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dency in the past has been to build a test facility for some purpose and then either junk it or salvage it at the completion of the test routine. Often these pieces of equipment are never scheduled into the flow charts of a project, so that duplication is frequent and therefore expensive.

Bendix has insisted these items be scheduled wherever possible, and has shown savings by shipping a piece of test equipment around a circuit where it can perform the same kind of work in different locations.

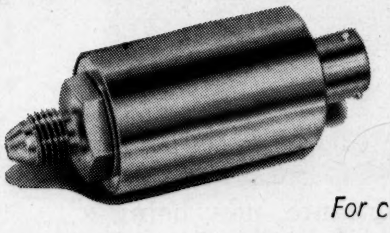
Navy wrote the contract on the basis of defining the end objectives of the total Eagle program, and covered the project from initial design through production and operational use with the fleet. The contract provides for money for the total program, although funding is on an annual basis.

There are open-end clauses that would permit contract changes to match changes in either systems techniques or the enemy threat. The intent of the Navy was not to tie down the project too firmly, but to arrange a program that could be flexible enough to reflect the state of the art.

Changes in the nature or numbers of the expected enemy threat, developments in the silent warfare of electronic countermeasures, major advances in propulsion systems or new techniques in guidance can all be fed into Eagle development.

Changes of this kind are bound to occur in the time lapse during any weapons system development, even those rushed through in a crash program. But Eagle's pace is slower.

By the time the Eagle gets into service, a decade will have elapsed from the original thinking that began the



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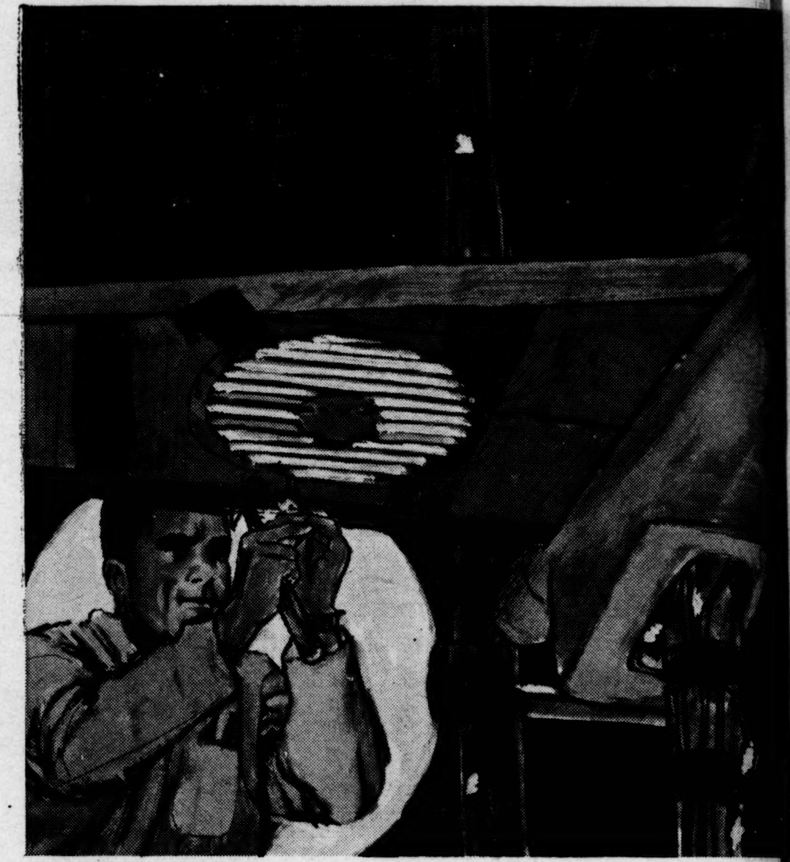
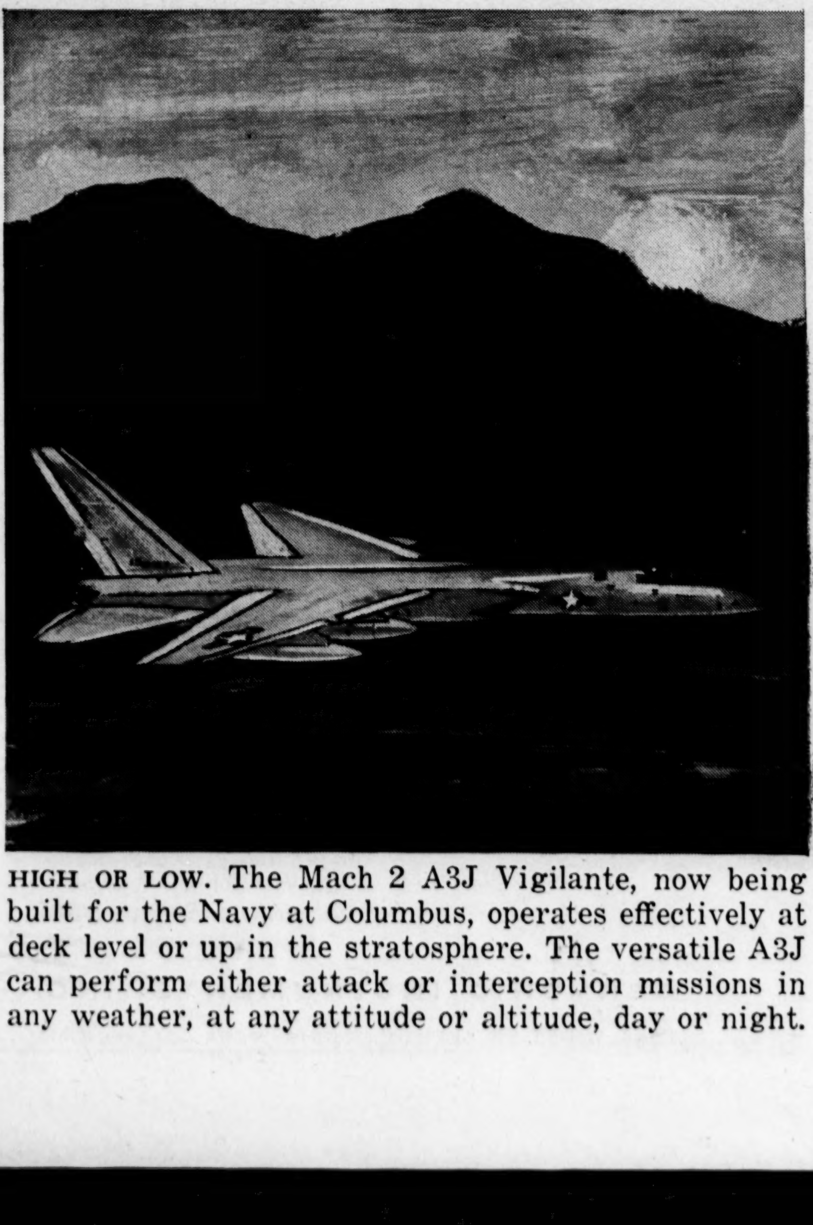
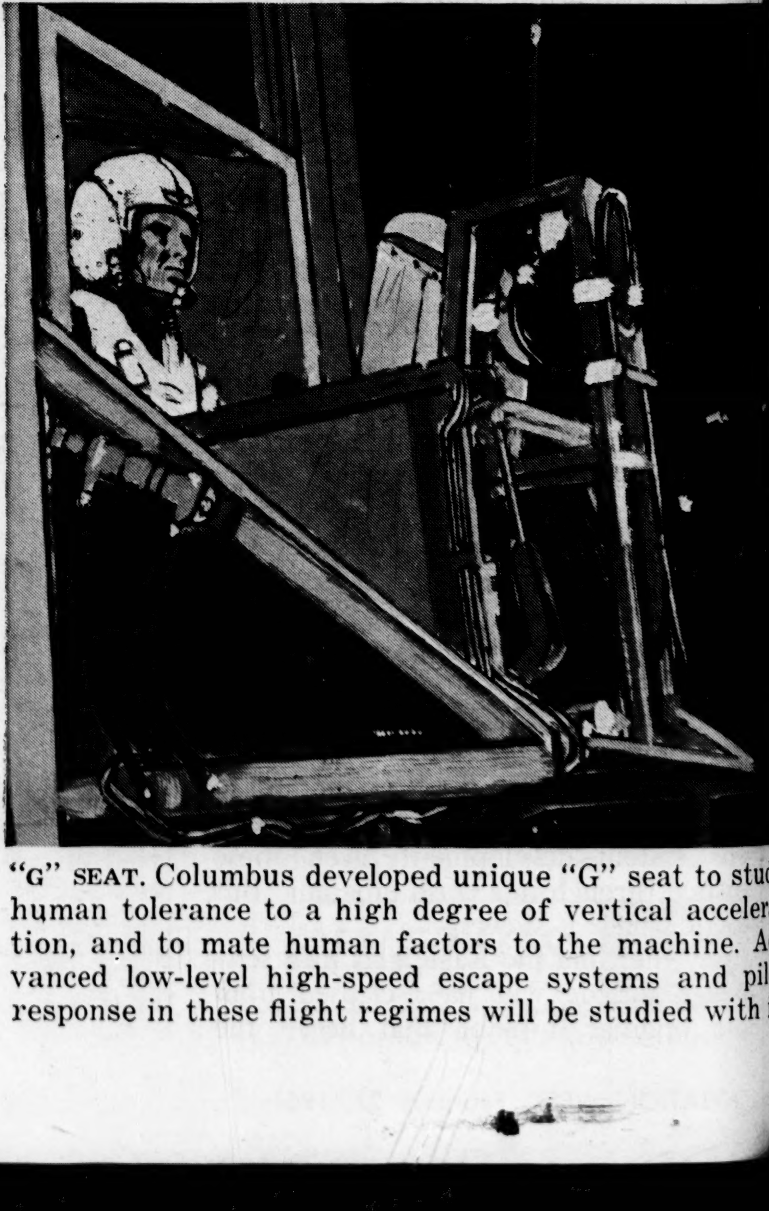


V/STOL FACILITIES. The Free World's largest wind tunn for the study of transition from vertical to level flig is a part of the facilities at Columbus. Other V/STO equipment includes six-degree-of-freedom flight sim lator, and zero-altitude, zero-speed escape system



HIGH OR LOW. The Mach 2 A3J Vigilante, now being built for the Navy at Columbus, operates effectively at deck level or up in the stratosphere. The versatile A3J can perform either attack or interception missions in any weather, at any attitude or altitude, day or night.



"G" SEAT. Columbus developed unique "G" seat to stu human tolerance to a high degree of vertical acceler tion, and to mate human factors to the machine. A vanced low-level high-speed escape systems and pil response in these flight regimes will be studied with

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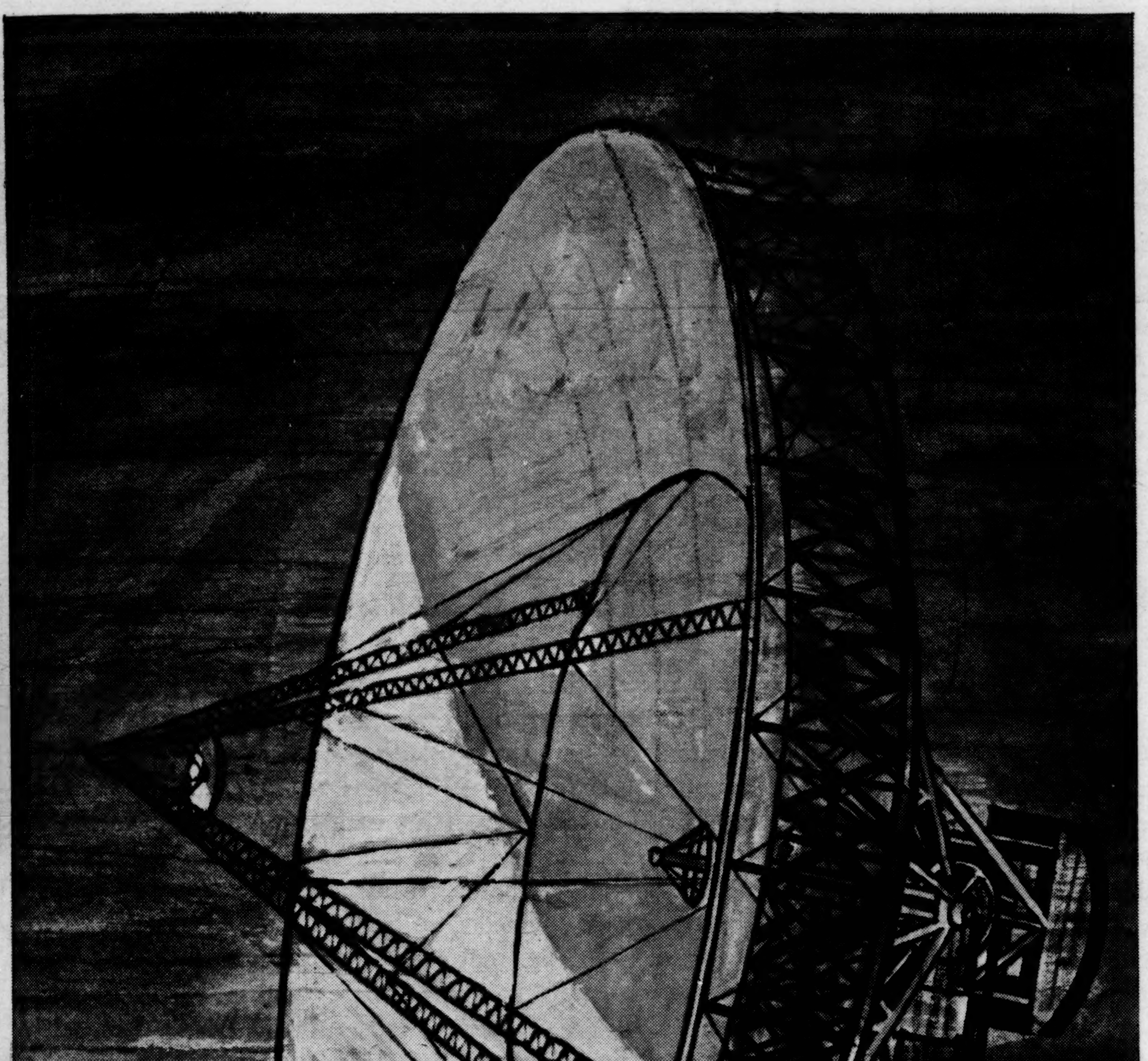


RADIO/RADAR ANTENNAS. An advanced type of antenna, constructed to such precise tolerances that it will be tuned to exact pitch, will be built by NAA-Columbus for the Air Force on "Haystack Hill" near Tyngsboro, Mass. Unique design developed at Columbus allows the rigid specifications to be met with significant reductions in dead weight, and in control power requirements.

program. The time span of the whole program, beginning with the first funding of design studies, is estimated at 10 years, with a total expenditure of $3.4 billion including procurement of the Missileer.

With the current status of the Missileer still uncertain, these cost estimates may be reduced if alternate plans to use modified aircraft go through. But either way, this multi-billion-dollar program is being planned to give the Navy a unique weapon, capable of performing missions that can not be done by any other defensive or offensive system, and capable of flexibility and versatility in handling a wide range of missions. As such, the program represents a new approach to the development and use of missile systems.

Army, Canada Join In Anti-ICBM Study

Washington—Canadian Armament Research and Delevopment Establishment (CARDE) has joined the Army Rocket and Guided Missile Agency in an investigation of ballistic missile defense problems and techniques.

Instigated primarily to aid development of elements of the Army Nike Zeus anti-missile missile system, the exchange will make indoor ranges available to the United States for tests of model ballistic missile nose cones in flight.

CARDE, an element of the Canadian Defense Board, is charged with providing advice and research on weapons systems.

CARDE is concerned primarily with aerophysics, infrared studies and propulsion.

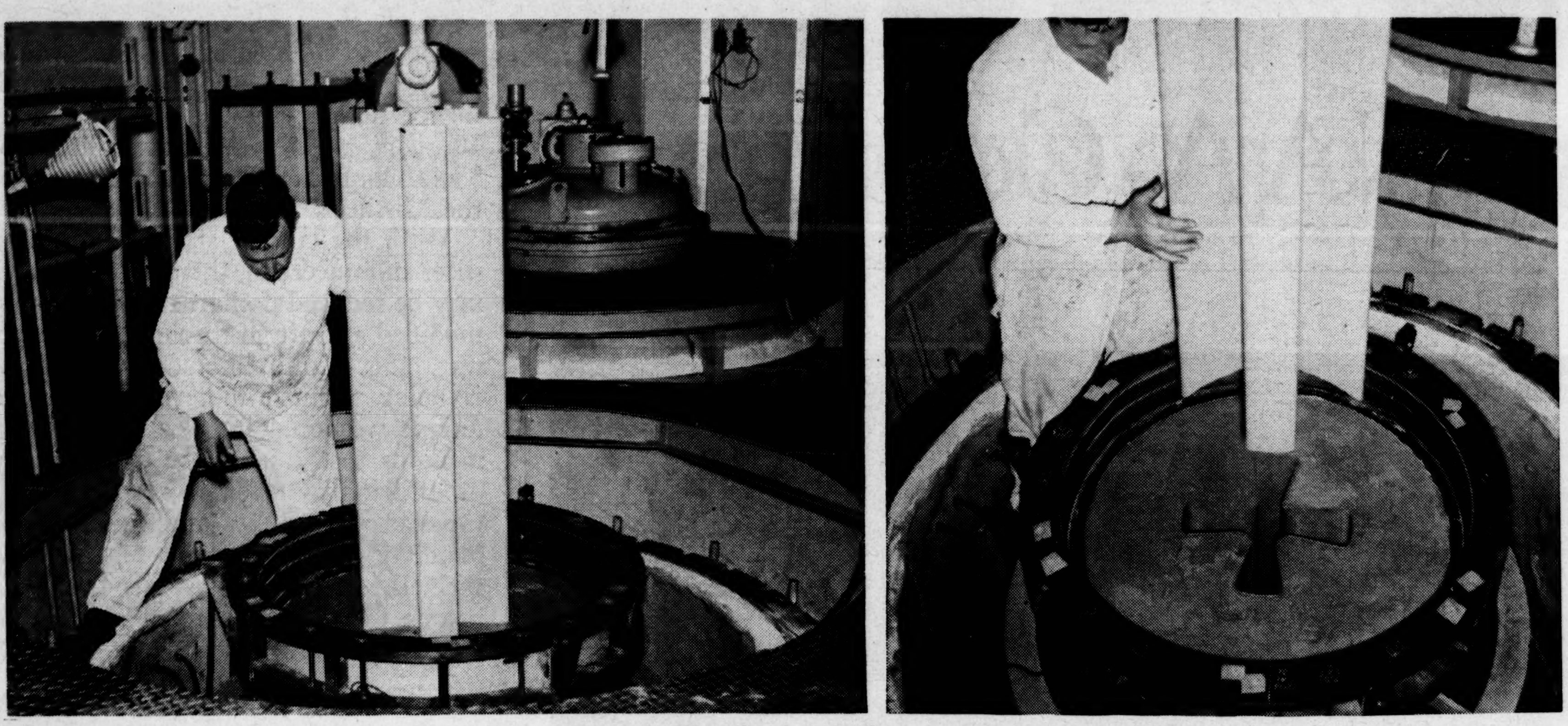
In the CARDE test facility, nose cones weighing up to 100 lb. are fired at high speed from gas-operated guns up to 14 in. in diameter, permitting studies of requirements for detecting and tracking incoming ballistic missile warheads.

NATO Nike Elements Organized Along Rhine

Bonn—Dutch and French anti-aircraft missile batallions are moving into position in the Rhine area to join American and West German units in the formation of a "Nike belt" to be based along the North Atlantic Treaty Organization's first line of defense.

Total of 12 Nike batallions, three of them German, will form the "belt."

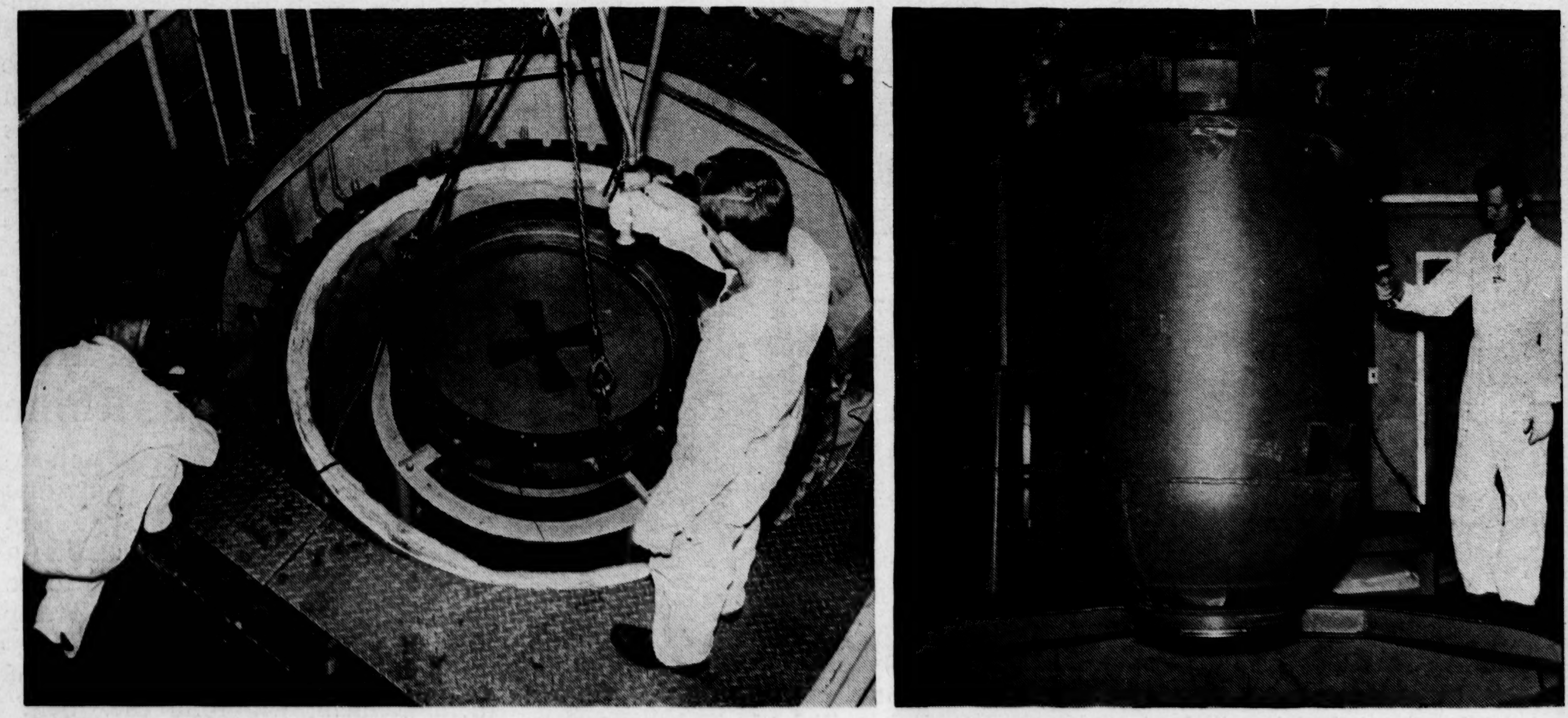
Missiles involved in the establishment of the 'Nike belt" include both the older Ajax and the more advanced Hercules.



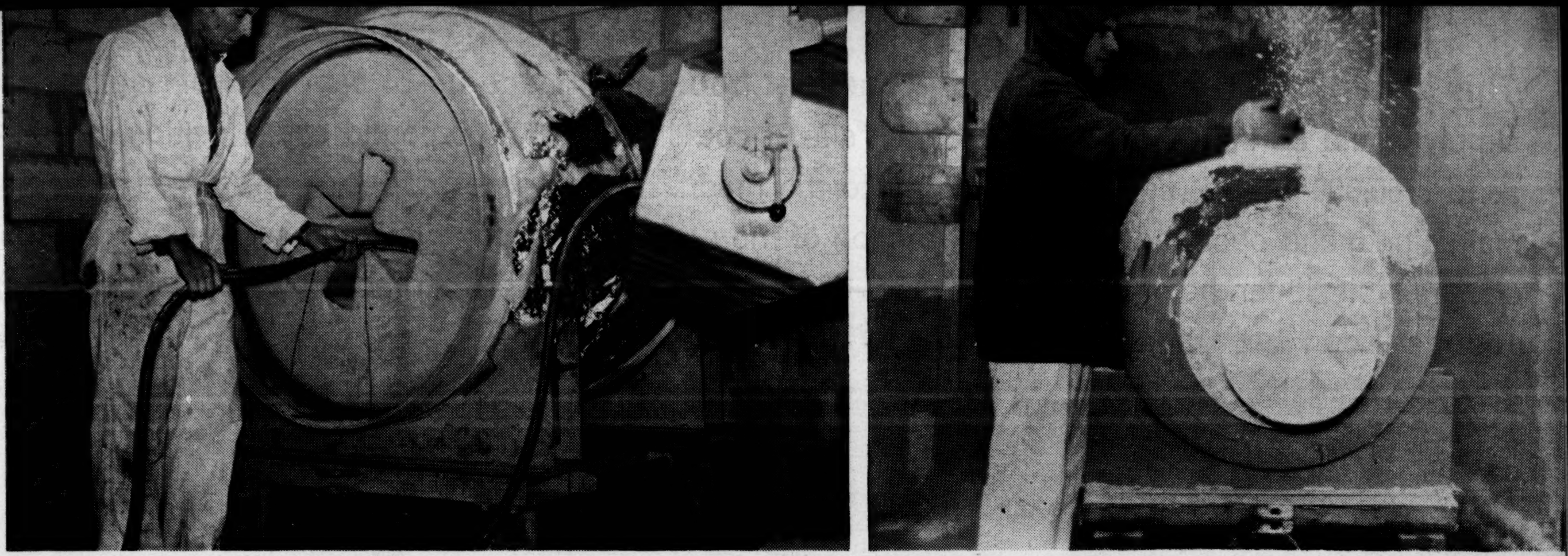
Teflon-coated aluminum mandrel is shown during removal. Flexadyne propellant used in motor has high tear resistance, a factor that aids mandrel removal after curing. Lid of casting bell is in background. With mandrel removed (right), star-shaped pattern of center cavity in propellant grain is visible. Smooth finish and absence of roughness or tearing where propellant was next to mandrel is evident.

Flexadyne-Propelled Rocket Engine Fired at −75F

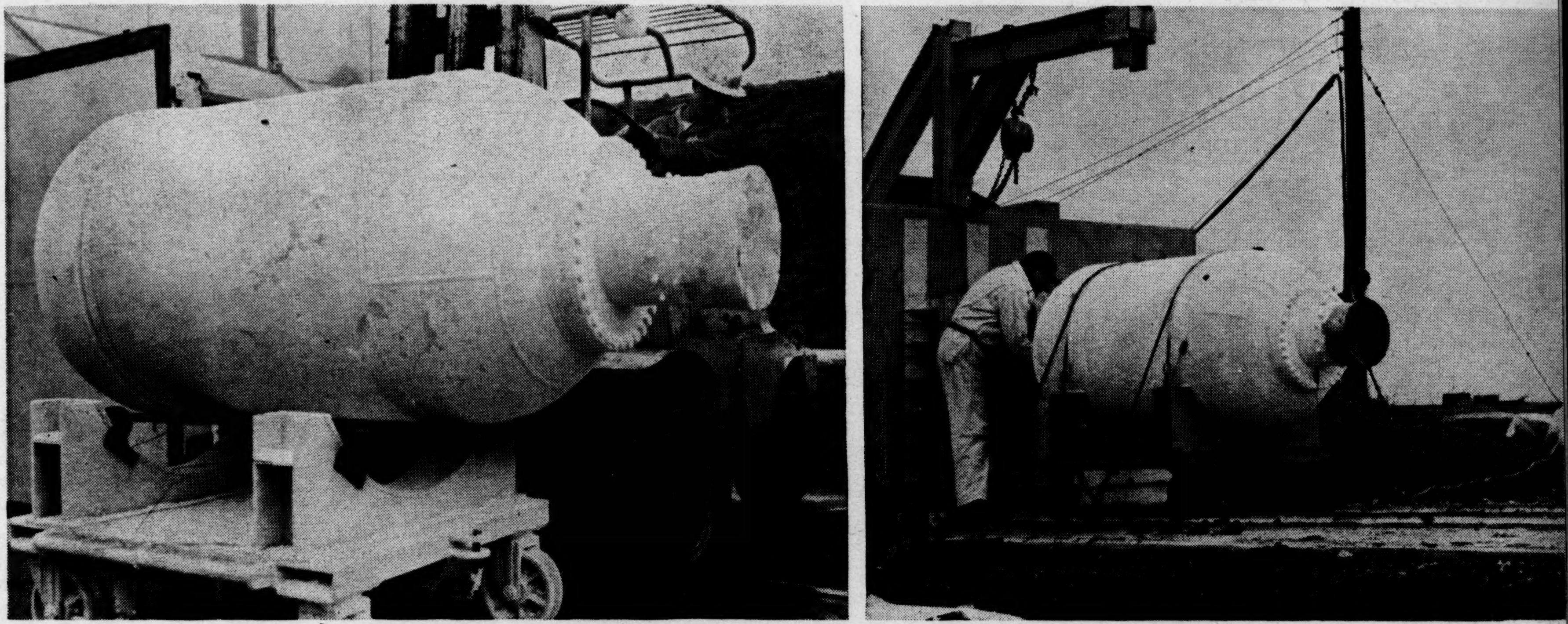
McGregor, Tex.—A 38-in.-dia. research rocket engine, containing some 3,500 lb. of Flexadyne solid propellant, has been fired here successfully at −75F for the first time. Officials of North American Aviation's Rocketdyne Solid Propulsion Operations here say that they believe that this test represents the largest solid propellant rocket motor to be cycled and fired at such low temperatures. Thrust rating was approximately 18,000 lb. Motor was made and tested under a USAF research contract. Prior to test firing, the case-bonded Flexadyne motor went through two complete temperature cyclings from −75F to 170F. X-rays taken prior to firing showed no evidence of internal cracking or separation of propellant from its case. Significance of this, according to Vice President T. E. Myers, is that it promises important advantages for tactical missiles, permitting operational reliability without need for special heating or handling equipment. Such propellant performance capabilities are also important in airborne missile operations. The successful firing was also considered significant because of the relative thickness of the propellant web in this motor. Web fraction of more than 50% indicates suitability of Flexadyne for very large solid rocket motors—such as in the one- to two-million-pound thrust class. Rocketdyne Solid Propulsion Operations engineers, prior to the 38-in. motor test, successfully fired 10-in.-dia. motors with Flexadyne propellant at −75F. These test specimens had been cycled five times between the −75F to 170F temperature range. The 10-in.-dia. test specimens showed no evidence of cracking. Flexadyne propellant family (AW Aug. 8, p. 80) is based on an advanced polybutadiene fuel-binder and features high resistance to cracking, tearing.



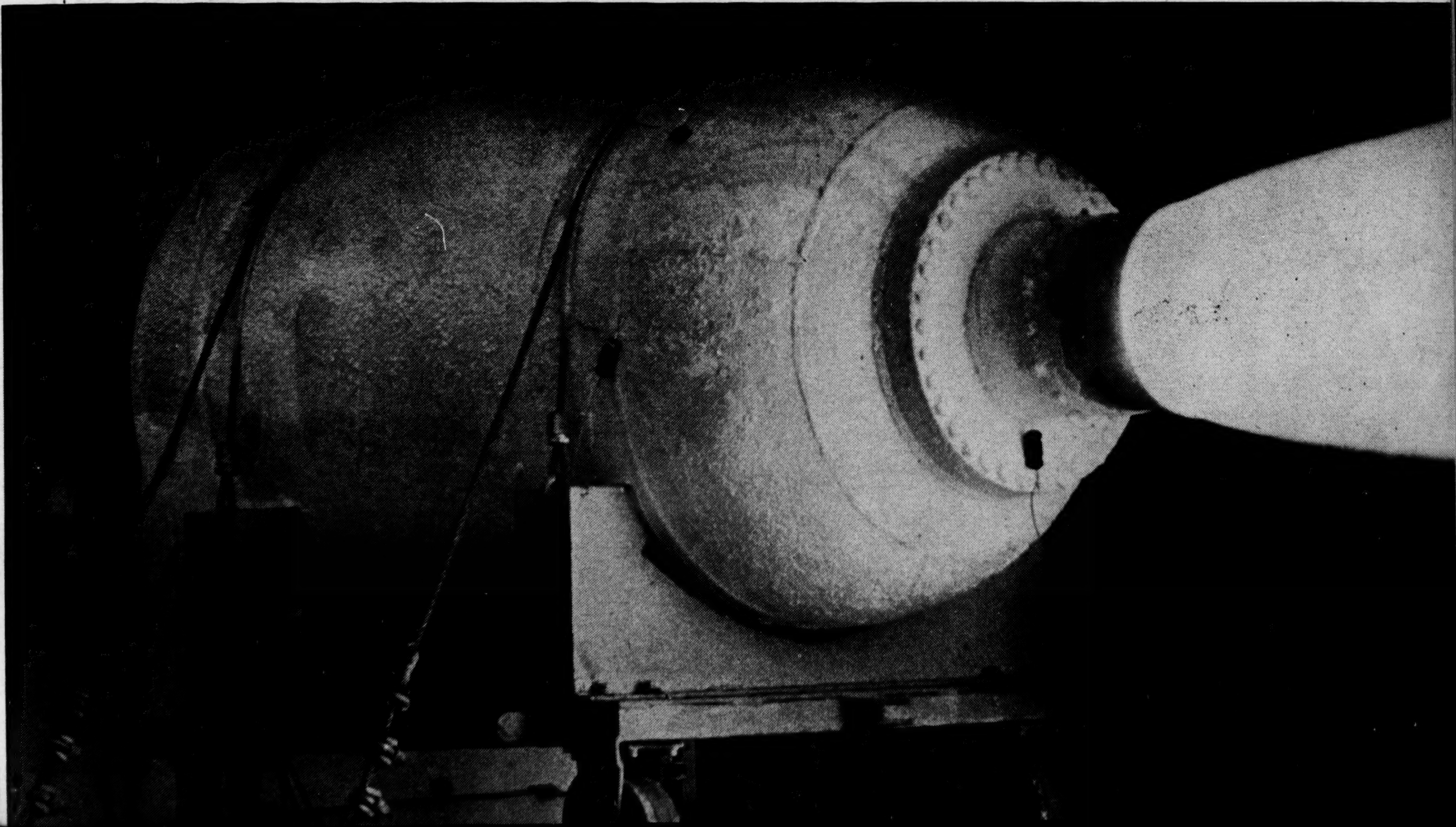
Technicians weigh loaded motor to determine final quantity of propellant. Exact weight, plus other known parameters of propellant burning characteristics and grain design, make it possible to predict performance of rocket motor. Motor is lifted from casting bell in preparation for removal to cold cell (right). Heavy wall case was manufactured of T-1 steel. Nozzle had high-temperature alloy throat insert and was plasma-coated with tungsten to protect it from over 5,000 deg. flame temperature.



After two complete temperature cycles, from 170F down to —75F, motor was inspected at —75F with two-million-volt radioisotope camera. Technicians found no evidence of propellant cracking or pulling away from case bonding. As last conditioning step prior to firing, nozzle and forward head were attached to motor and unit was given final chilling to —75F (right). Each complete cycle from 170F to —75F and return took approximately two weeks. Here, frost-covered motor is removed from cold chamber.



Chilled motor, containing some 3,500 lb. of propellant, is moved immediately by forklift truck to test firing stand. Tape was left on nozzle opening during cycling to keep moisture from propellant. Motor is tied down in test stand (right) and igniter installed in preparation for firing (below). Insulation blanket was used to hold motor at —75F during move from cold cell to firing stand. Thermocouples for measuring case temperature rise in insulated areas are visible around aft end.



This gigantic GCR-proposed solid propellant booster is made up of easy-to-haul segments that simply would be bolted together at launch site. It could put a 250,000-pound space station in orbit—or send a 60,000-pound manned spacecraft to the moon. It can be developed, built, tested, assembled, maintained, and operated for a small fraction of the cost of a comparable liquid system—yet it is much more reliable. It can be operational by 1967—if we start now. Smaller solid boosters—able to orbit 30,000 pounds—can be available by 1964. **GRAND CENTRAL ROCKET COMPANY**
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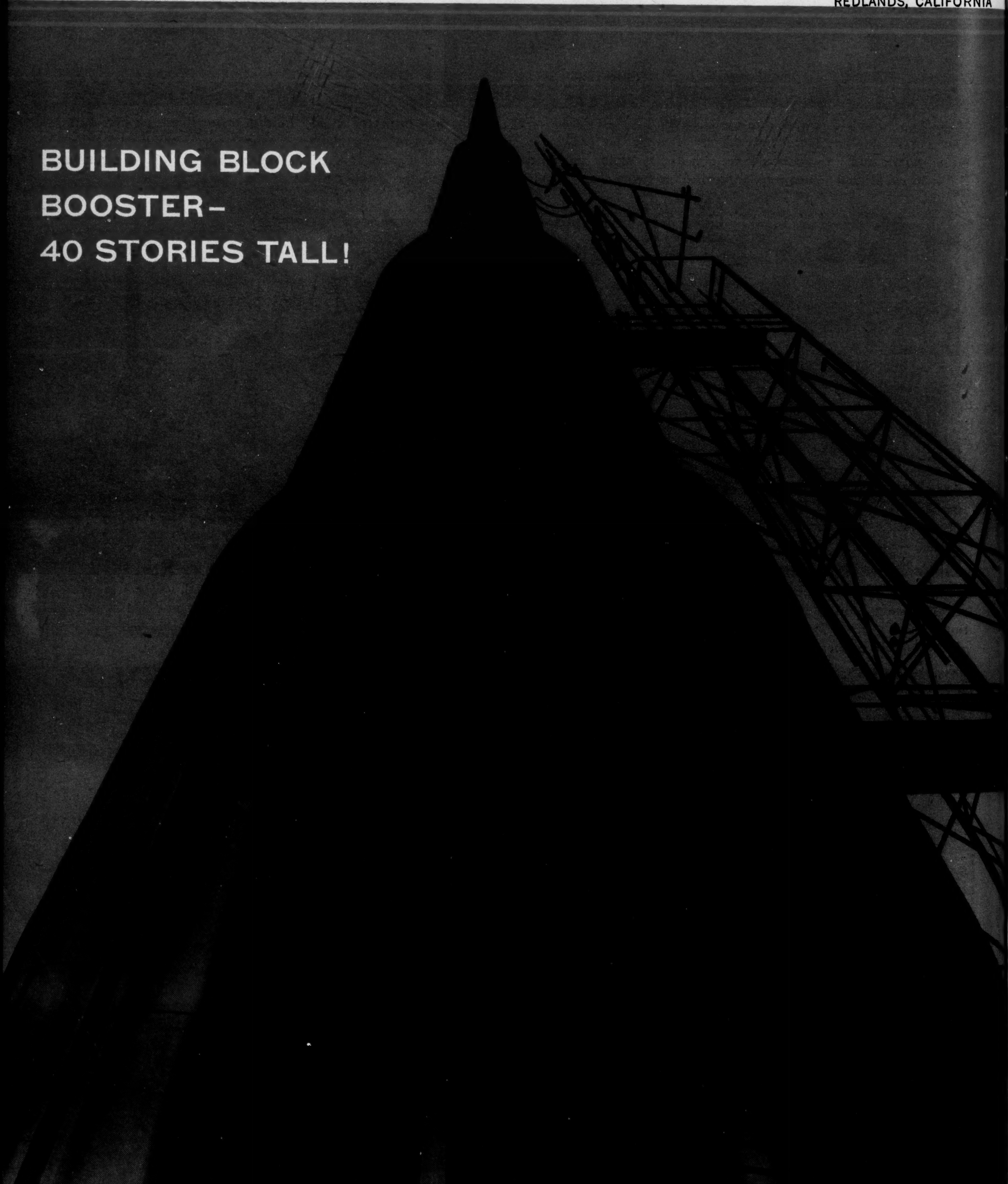
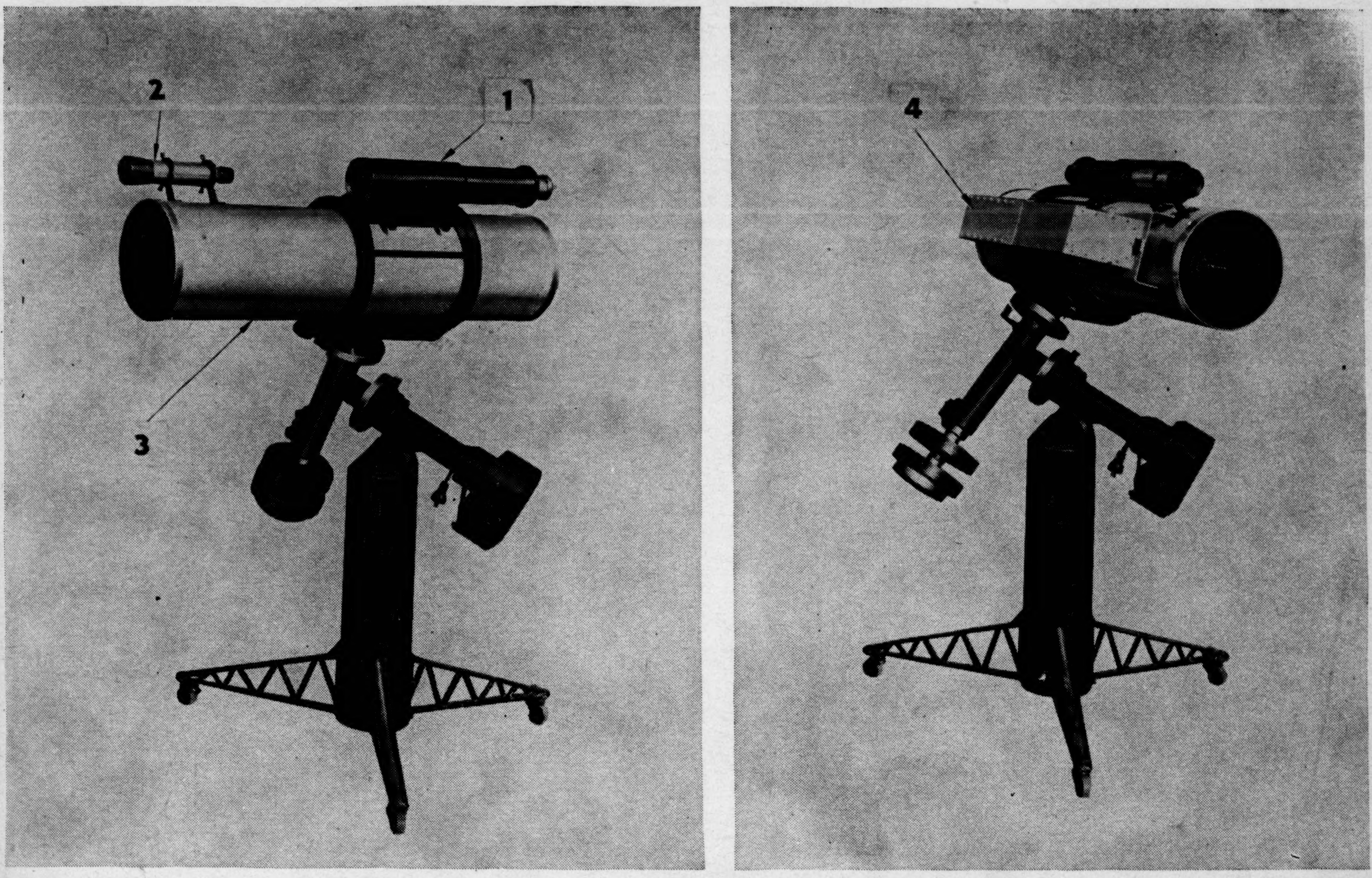


AVIONICS



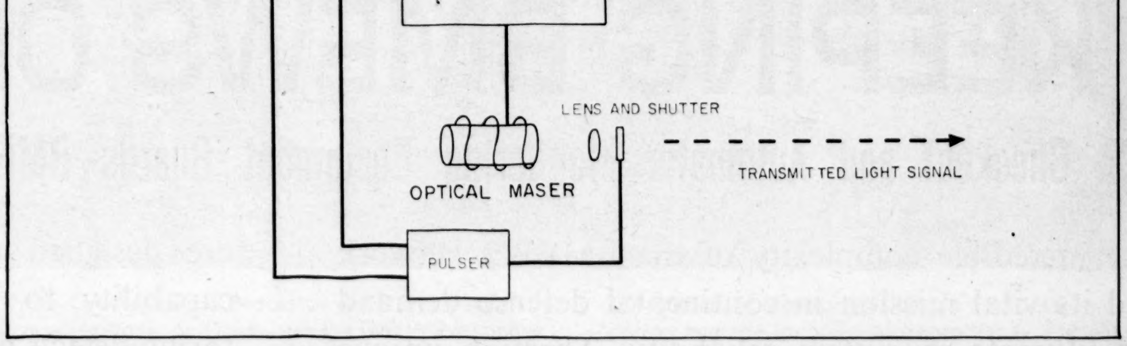
EXPERIMENTAL coherent optical radar (left), which is operating successfully at Hughes Aircraft Co., employs pulsed ruby optical maser transmitter (1) attached to side of telescope receiver (3). Such systems promise to better angular resolution of present radars by at least several orders of magnitude. In modified version of same radar, sighting scope (2) is at rear of receiver. Calculations by company scientists indicate that first experimental models will range several hundred miles in space where atmospheric absorption and scattering of light are no problem. Second view (right) shows how amplifier and associated avionics (4) are mounted to telescope.

Hughes Develops Coherent Optical Radar

By Barry Miller

Culver City, Calif.—Experimental models of coherent optical radar systems with unusually high angular resolution have been operated recently by Hughes Aircraft Co. scientists only nine months after another company scientist scored the basic technological advance which made them feasible.

The new radar, which Hughes calls Colidar, an acronym for Coherent Light Detection and Ranging, became possible with the development early last summer of the first optical maser (AW July 18, p. 96). It is the coherent narrow beam of red light generated by the maser which forms the basic signal of the new radar and is the source of its principal potential advantage—exceptionally high angular resolution. This high angular resolution—a measure of a radar's ability to isolate a single target within a cluster of closely spaced targets—probably will make Colidar extremely attractive to military services for use in space. For it is outside the earth's atmosphere where light waves are not



COHERENT optical radar system, called Colidar (Coherent Light Detection and Ranging), employs ruby optical maser as transmitter. Light pulses are collimated by lens, trimmed by shutter and then emitted toward distant target. Returns are collected by mirror system in telescope, detected and then processed conventionally. Because of narrow beams of even first-generation optical masers, system provides two orders of magnitude improvement in angular resolution over present radars. First experimental systems have ranged off diffuse targets about three miles during clear, daylight conditions.

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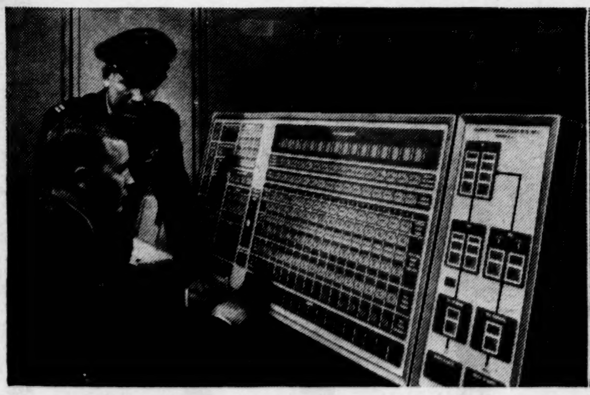
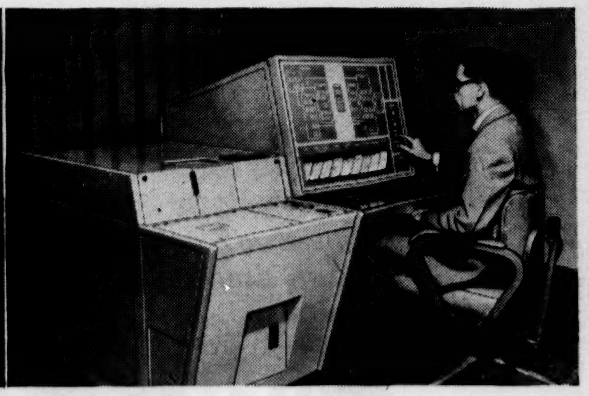


The Central Automatic Monitoring Console displays the status of the entire site, and displays equipment degradation prior to failure.

The Checkout Data Processor generates simulated missile attacks and evaluates the BMEWS response to the simulation.



The Automatic Monitoring Console displays degradation and the location of degraded equipment.

RCA Checkout and Automatic Monitoring (CAM) Equipment has greatly enhanced the reliability of complex ground environment systems. Adaptable for use in systems already completed, and as an integration tool for systems currently being implemented, CAM equipment is available for all complex commercial, military, and government systems. For a description of the RCA Checkout and Automatic Monitoring Equipment, write to: RCA Major Defense Systems, **Defense Electronic Products,** CAM 127-204, Moorestown, New Jersey.

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Rocket Operations Center: Ogden, Utah
Nike-Zeus Motors produced at the Redstone Division

subject to absorption or scattering that optical systems become competitive with conventional radio systems.

At present, however, the Hughes optical radar development is in its infancy. Some of its components are largely the makeshift parts characteristic of early experimental work. The system has ranged over only relatively short distances (3 mi.). Yet its operation demonstrates the capability of coherent optical radar to range off diffuse targets during daylight hours.

The potential which proponents of optical masers predicted for coherent light radar before it was a reality (AW Dec. 14, 1959, p. 87) may soon emerge. Due to the optical maser's ability to generate a sharply collimated beam of single wavelengths (10 million times as single-colored as sunlight), the beamwidths of the experimental system—a direct function of a radar's angular resolution—are two orders of magnitude better than those of current operational radars, according to Hughes. Ultimately, these output beamwidths should become even better (more narrow) with the use of better quality ruby crystals in the maser.

To get the same narrow beam effect with an X-band radar would require a prohibitively large dish, points out Dr. Malcolm Stitch, who heads the Colidar development here at the Engineering Division.

Earlier Experiments

The idea of optical radar is not new. Several optical radars have been proposed, built and used for short-range applications in the years since World War II. But these systems use incoherent light sources—such as carbon arcs or other discharge sources—which generate a mixture of light waves in different directions. To obtain the narrow beam effect comparable to that provided by optical masers, a reflector must be employed to concentrate the waves. To match the maser's intensity, the incoherent source must be increased in size, thus requiring larger antennas to achieve a narrow beam effect.

First experimental Colidar systems display favorable signal-to-noise ratios, as shown in an accompanying photograph of a dual-gun oscilloscope recording of Colidar pulse trains (p. 68).

As shown in a block diagram of the complete system (p. 61), the Hughes optical radar consists of a ruby optical maser which serves as the transmitter and a slightly more complicated telescope-mirror-electronic combination. The transmitter is attached to the side of the telescope.

Because the ruby optical maser does not generate as narrow a beam as theoretically possible due to imperfections in and improper distributions of chromium impurity atoms through the crys-

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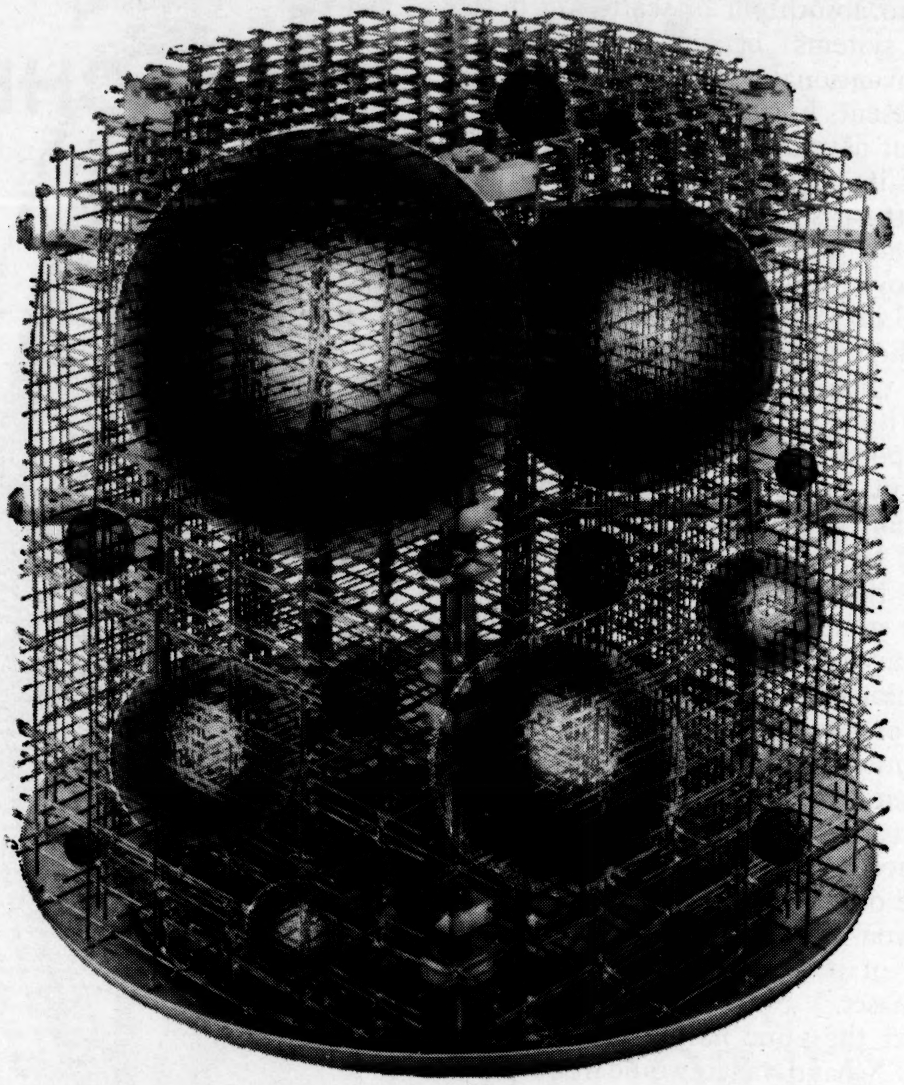

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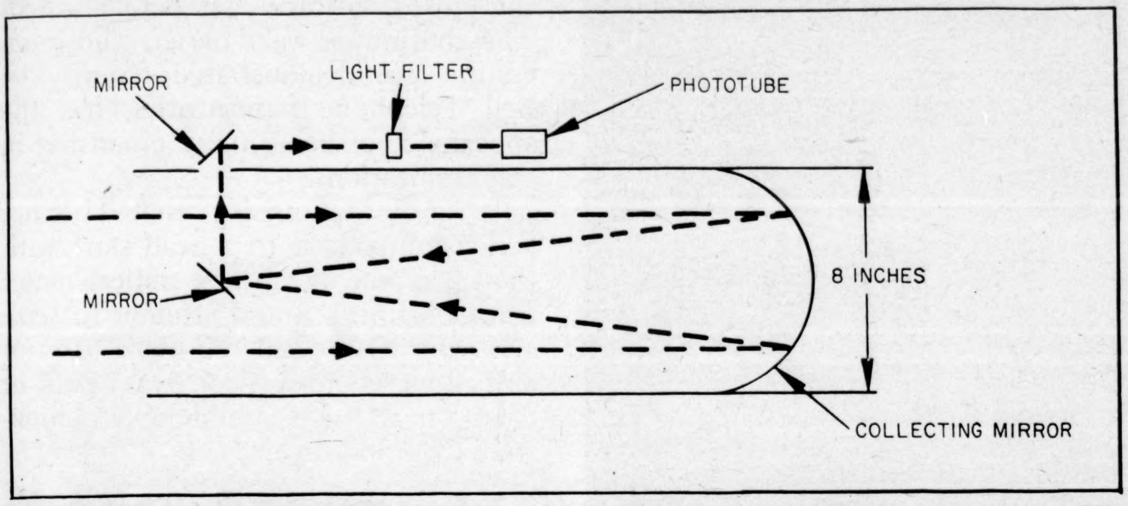

REFLECTED LIGHT SIGNALS of optical radar in development at Hughes Aircraft are collected by mirror at the rear end of a telescope, focused back into a second mirror and then reflected by a third mirror through a light filter into phototube. Signals are then amplified, processed and displayed in remainder of receiver.

tal, a lens system is employed to further collimate the beam. Beamwidth of the maser output is about nine milliradians; after passage through the lens it is reduced to ⅓ milliradian. Theoretically, Hughes says, maser output itself could be reduced to seven microradians. The present beam, Hughes says, is capable of discriminating between objects 10-ft. wide placed next to one another at 10,000 yd.

The maser generates a pulse about three milliseconds long at a wavelength of 6,943 angstroms (roughly 430 megamegacycles, or about four orders of magnitude above the upper end of conventional X-band radar frequencies). To cut off undesired trailing edges of this pulse some type of shuttering such as that produced by a Kerr cell, or such as might be possible to achieve with control from ruby itself, is then employed. Hence, the optical maser, its power source, a lens and shutter constitute the transmitter.

Returns from the signal transmitted by the maser and its optical system are collected by a 38-in.-long telescope. At the rear of the telescope an 8-in.-dia. mirror collects the reflected energy and focuses it back onto a smaller mirror near the front of the telescope. The light beam is then reflected through a hole in the side of the telescope onto a third mirror, then passed through a narrow band light filter which reduces the noise. The light finally strikes a phototube, and the resulting electrical signal is amplified, processed and displayed.

Actual pulse repetition rate for the system presently is limited to about one pulse a second because of power source heating of the crystal. A timing pulse to indicate when the transmitter generated its light signal is provided by a simply-fashioned wire mechanism which scatters a fraction of the transmitted light onto a timing device which triggers a time reference.

Hughes scientists stress that Colidar is still in its early stages. Each day brings adjustments in the equipment aimed at improving its operation. The present 3-mi. land range probably can be doubled, the company says, when a 6-angstrom filter replaces a 60-angstrom unit now being used in the receiver.

Actually, the radar development is the result of two parallel and similar efforts, the one under Dr. Stitch here and another, directed by Dr. George Smith of the company's research laboratories in Malibu. Both programs are progressing at about the same pace with the results of one group being duplicated by the other on a day-by-day basis, according to Dr. Rex C. Mack, who is coordinating optical maser activities at Hughes. Dr. Smith and his colleagues plan to present a report on their work at next month's Institute of Radio Engineers convention in New York.

Pulse Control

One unusual feature of the system is the manner in which the shape of the pulse which excites the maser is controlled. A pulser, shown in the system block diagram, controls the flash pulse. A high-voltage power supply, feeding a delay line in parallel with an ignition and in series with a flash tube, comprise the control. When the ignition is fired, the delay line discharges through the flash, providing a well-defined short period pulse.

It is too early to be certain of precise power relations and weight of final Colidar equipment. Experimental gear—which is far from an optimized version—weighs about 25 to 30 lb. Power output is in excess of a kilowatt and the basic device is about 1 to 10% efficient, Dr. Mack says.

Limits on the operation of the present equipment, Dr. Mack adds, are:

- **Beamwidth**—To realize ultimate narrow beamwidth potential of optical masers will require better quality crystals.
- **Optical filter**—Since further improvements in signal/noise of the beam can be achieved through filtering, present

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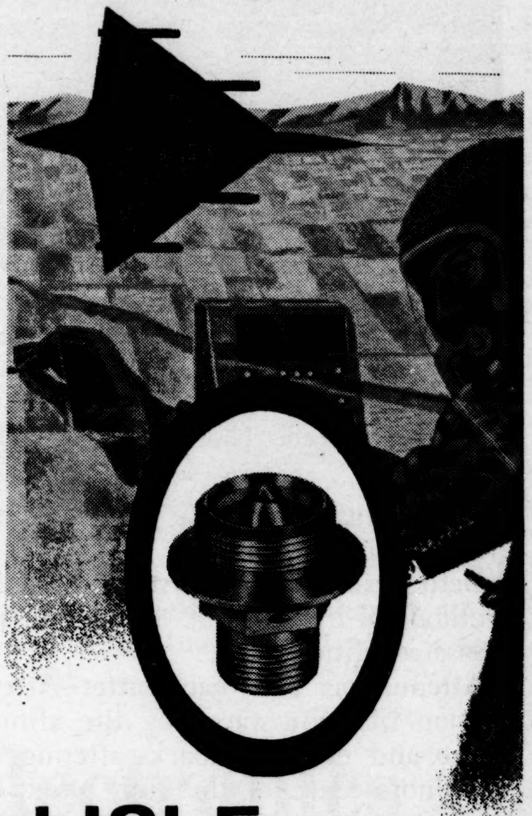

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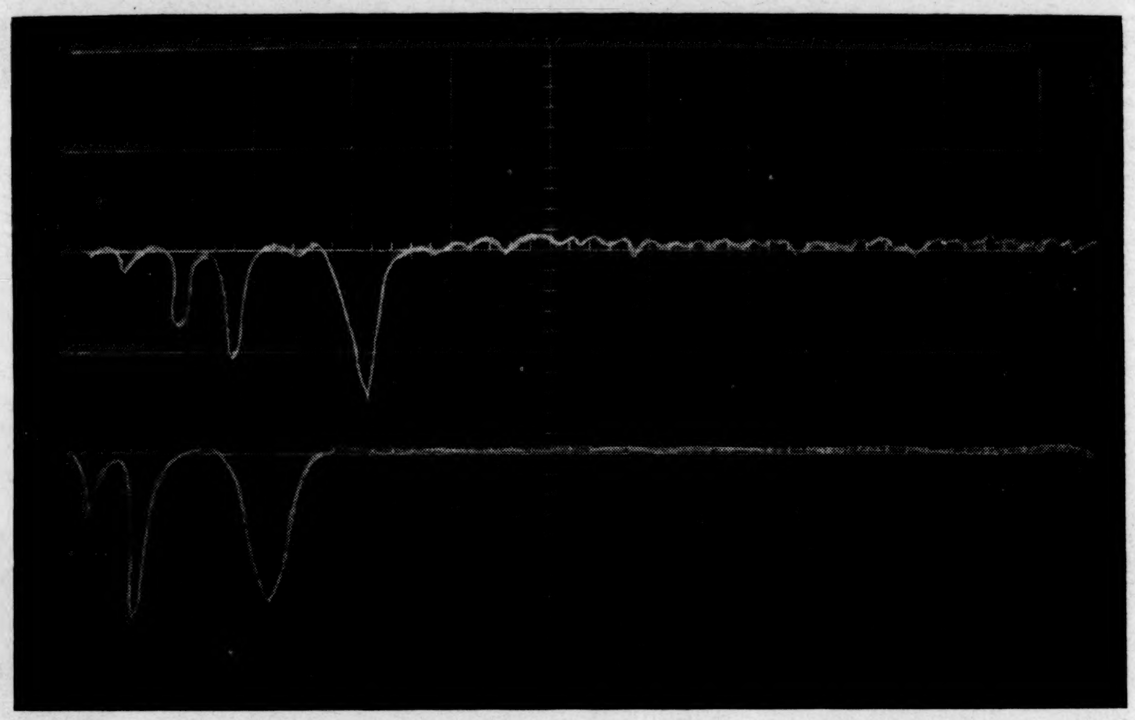


PULSES transmitted (bottom) and received (top) by Hughes experimental coherent optical radar are shown in Polaroid photo of dual-gun oscilloscope tracings. Both traces were triggered by the first pulse of a set of three pulses. Target was a billboard about 1,000 ft. from the radar at company's plant in Culver City, Calif. Oscilloscope sweep speed is set at 2 microsec. per cm. Photo was retouched by Aviation Week for clarity after reproduction.

filter eventually will give way to a one-angstrom unit.

- **Better excitation of crystal**—Improved methods of exciting the crystal will increase repetition rates.
- **Attenuation and backscatter**—Attenuation of light waves by the atmosphere and even the backscattering of the fluorescence of the ruby itself by the atmosphere are an imposing limitation on the use of optical radar in terrestrial applications. In fact, Dr. Mack indicates, Colidar can probably only be used effectively in space where atmospheric problems are absent.

For space applications, the Colidar would offer a number of possible advantages including its good angular resolution, light weight, probable low power requirements, and/or relatively long range. Hughes scientists speak of hundreds of miles of range for Colidar in space.

Because of the very narrow beam, acquiring a target is difficult and might require acquisition by other means. Yet the system would be all but impossible to jam, requiring generation of a frequency almost identical to that of Colidar and on a line-of-sight with it.

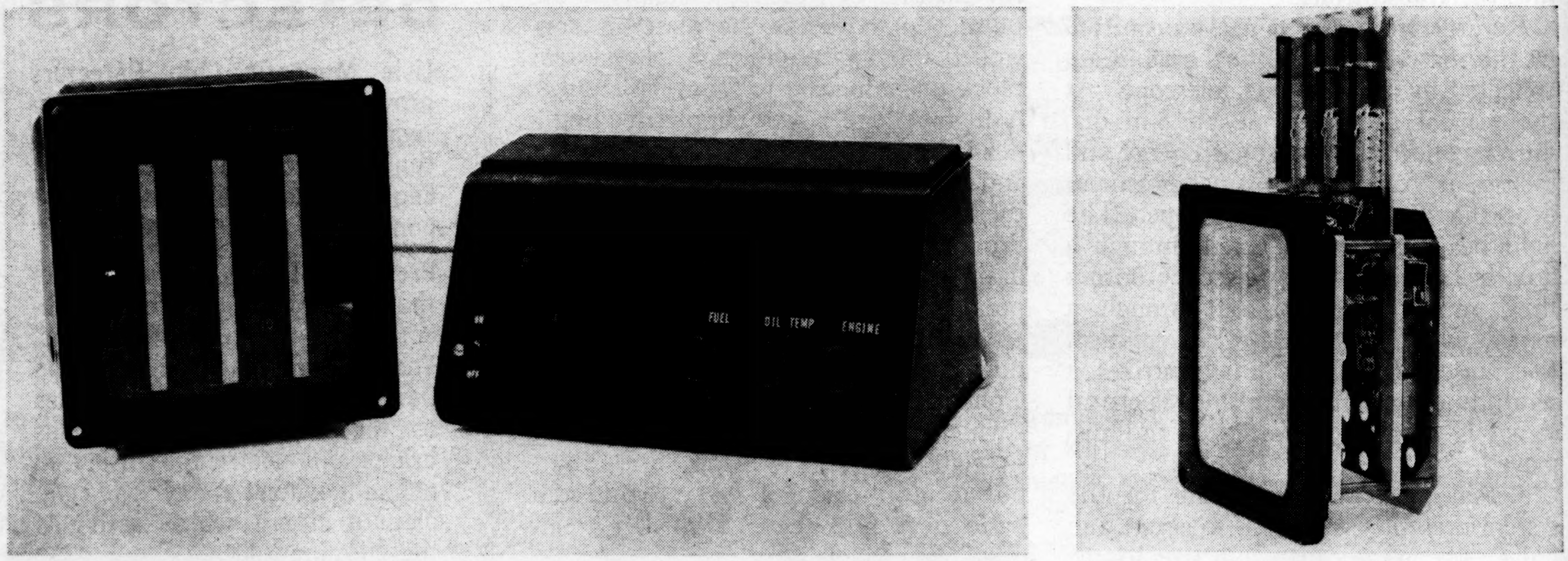
Development of optical radar marks the first avionic application for which the pulsed optical maser is well suited. The continuous wave maser, whose operation was demonstrated recently by Bell Telephone Laboratories, has the appearance of being more promising in communications.

It is not surprising that Hughes, which jumped off to a head start with the operation of the first optical maser in this country, would attempt to seize a leading position in the application of optical masers to systems in the field of radar where it has considerable demonstrated competence.

Sampling of Sonobuoys To Receive Sea Tests

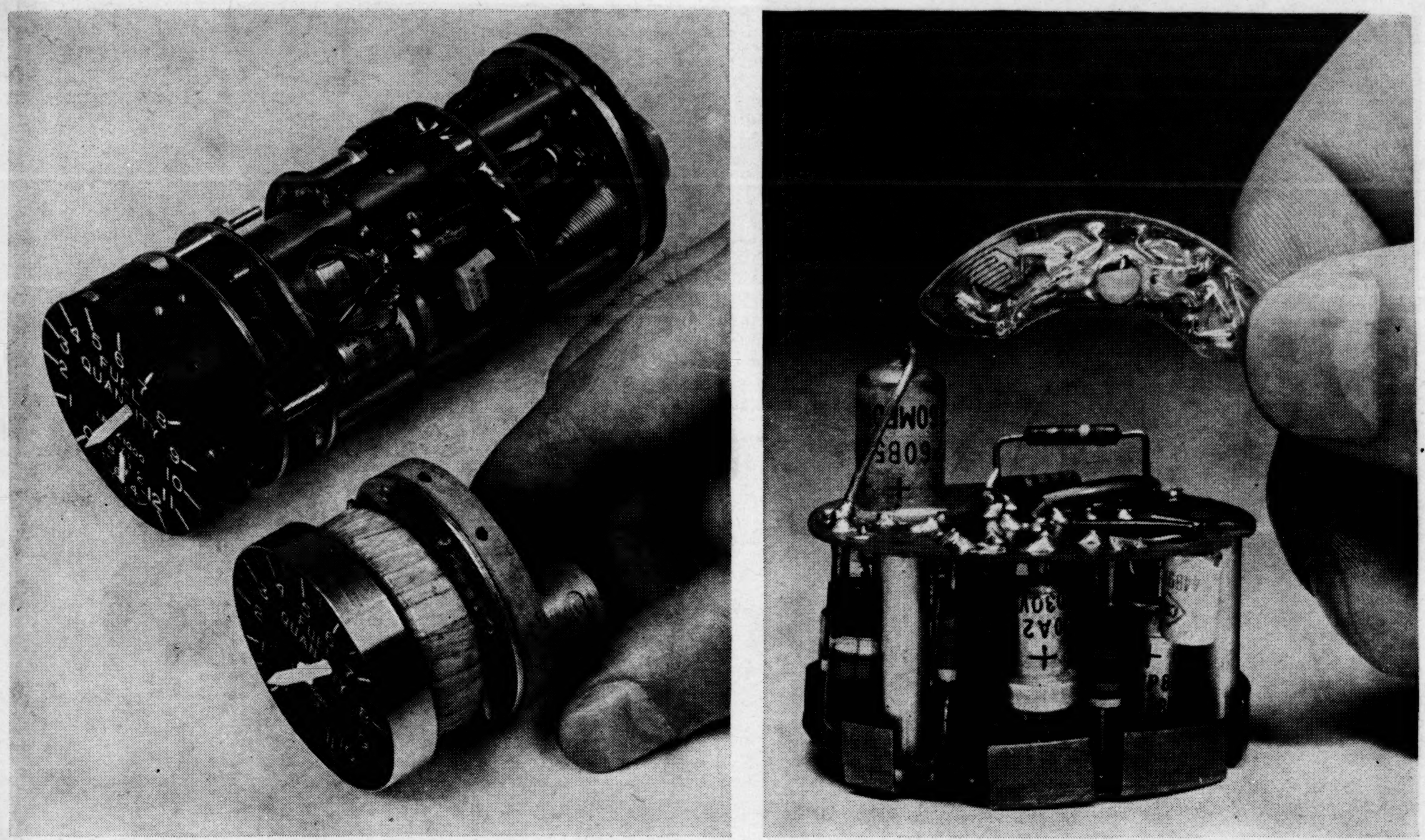
New York—Sample lots of all sonobuoys for Navy anti-submarine warfare (ASW) aircraft will be tested under operational conditions in an ocean area off Pemaquid Point, Me., before procured quantities are released to fleet units.

Vocaline Co. of America, Inc., Old Saybrook, Conn., will run the test program for the Bureau of Naval Weapons and will determine performance and reliability of sonobuoys made by various manufacturers. Sonobuoys under test will be dropped into the ocean five miles southeast of Pemaquid Point by a Navy P2V and compared with a master sonobuoy, dropped several hours earlier and checked out against two slave sonobuoys, for acoustic threshold, frequency and beacon response and power. Master buoy, remotely controlled from a ground station, transmits varying frequencies and volumes to simulate submarines.



Electroluminescent Cockpit Indicator Displays Engine Data

Electroluminescent cockpit indicator which provides convenient readings of aircraft engine speed, oil temperature and fuel consumption rate was developed by Lear's Solid State Physics Laboratory and delivered to contracting agency, Naval Air Development Center, Johnsville, Pa. Each of three indicator columns is composed of 100 electroluminescent strips. Successive strips luminesce when analog signal corresponding to parameter being measured changes bias on an RF oscillator, which then alters degree of ionization in neon tube. This in turn excites photoconductor whose output causes electroluminescent strip to light. Use of electroluminescent and photoconductive phosphors may make more reliable, smaller and lower power indicators possible. Lear now has second phase contract of $194,000 to develop two-dimensional (x and y) indicator for Air Development Center.



HONEYWELL has slashed size and weight of its standard fuel gage indicator (rear) in new experimental model (front) through use of similar micro-electronic construction techniques. Micro-Electronic three-stage amplifier, built by Honeywell on glass substrate, is used in B-58 center-of-gravity control, replacing conventional amplifier shown directly underneath.

Honeywell Expands Micro-Electronics

By Philip J. Klass

Minneapolis—Minneapolis-Honeywell this year will double the size of its company-financed program in micro-circuitry and molectronics, a broad-gage effort intended both to apply available techniques to today's hardware and to develop the more advanced techniques required for the coming decade.

The company has budgeted approximately $750,000 for the current year, roughly twice the amount funded last year. Much of this will go into basic research in materials and thin film technology which a few short years ago might have been considered far too esoteric for a company like Honeywell.

The company already is applying deposited resistor-conductor techniques to subsystems and instruments which the Aeronautical Division is delivering. For example, Honeywell has produced a number of center-of-gravity fuel control systems for the Convair B-58 which uses a tiny three-stage direct-coupled transistor amplifier whose resistors and conductors are produced by vacuum deposition.

Honeywell's program is being carried on in three divisions: Aeronautical, Semiconductor and Research. It is being directed along four different paths in the broad spectrum of micro-electronics and molectronics, distinguished by differences in technology and anticipated availability timetable:

- **Type 1:** Use of vacuum-deposited passive components, including conductors, resistors and capacitors, with conventional and/or micro-transistors and diodes. This effort, primarily in Honeywell's Aeronautical Division, aims at immediate application of existing techniques and improvements in these techniques.
- **Type 2:** Solid-state circuits in which simple functions such as a flip-flop, amplifier or an adder are fabricated on a single semiconductor substrate. This work is being carried out by company's Semiconductor Division in West Palm Beach, Fla. Application of these techniques is expected to begin this year.
- **Type 3:** Thin film circuits, both magnetic films for digital computer use and semiconductor thin-film active elements and circuits for general application. This phase of the company effort is being carried out by the Research and Aeronautical Divisions, with first applications expected to start by 1963.
- **Type 4:** Molecular electronics, or the fabrication of complete functional subsystems as integral circuits, is expected to find initial use also around 1963-65. Techniques and knowledge coming out of the research in thin films, solid-state circuits and materials are expected to merge for molectronic applications. Primary work on this type is in the Research Division.

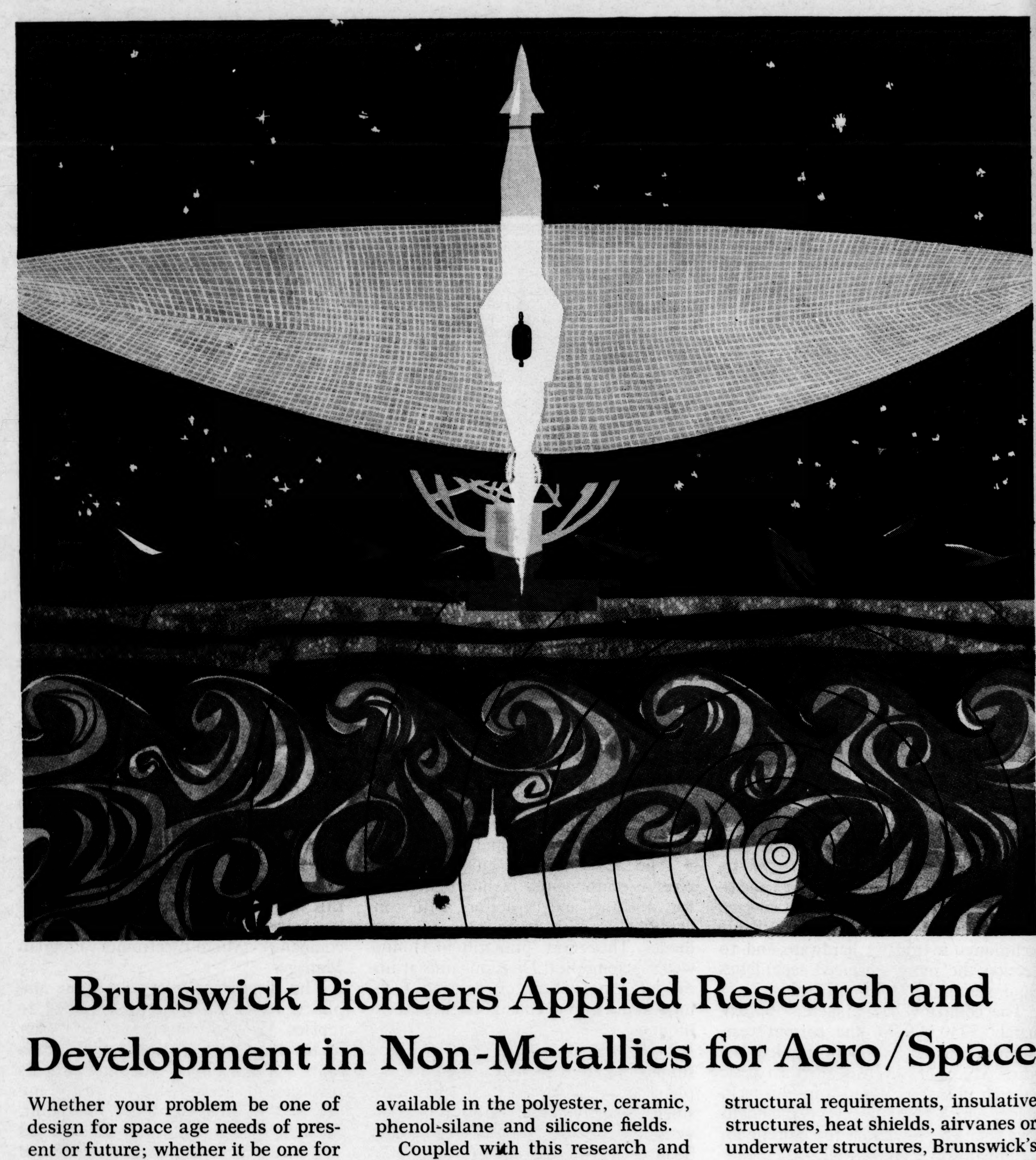
To integrate and direct the efforts of this multi-division program, Honeywell has named Judd C. Nicholas as the company's Micro-Electronics Program Manager.

The three-stage micro-electronic amplifier, which Honeywell developed to replace a more conventional amplifier in the B-58 fuel control system, represents a 97% volume reduction over its predecessor (see photo). Equally important, from a reliability viewpoint, the new amplifier has only 15 soldered and mechanical connections compared with 210 connections in the previous design.

The B-58 micro-amplifier is fabricated on a thin glass substrate which is shaped in the form of a sector of a doughnut whose outer diameter is 1.8 in. and whose width is 0.7 in.

A combination of photo-masking and vacuum deposition techniques is used to fabricate the copper conductors and the nichrome resistors on the glass substate. Conventional transistors are mounted in three holes in the substrate after the resistors and conductors have been fabricated.

Honeywell is able to produce depos-



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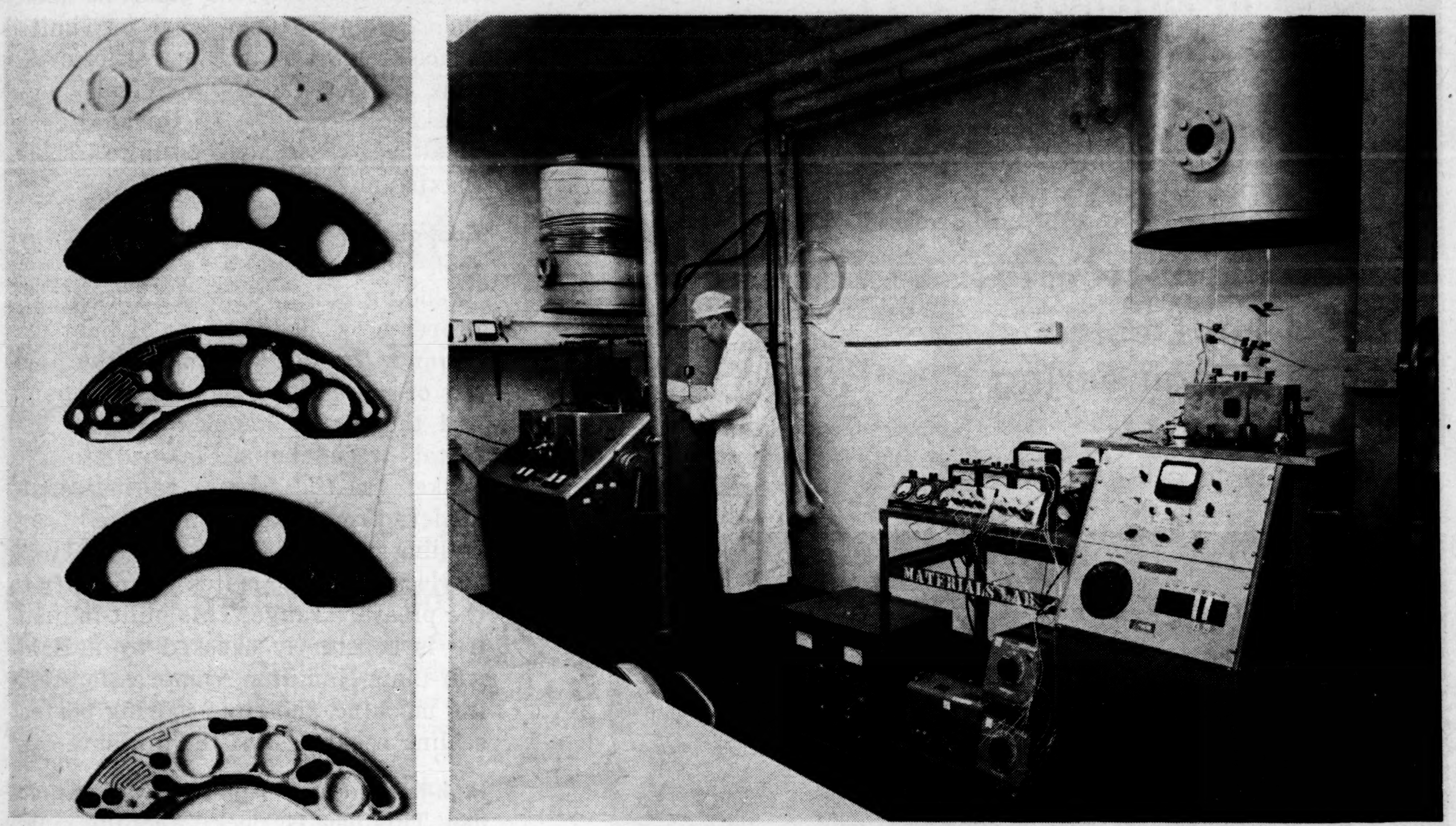


VACUUM DEPOSITION and photo-etching processes are used to produce nichrome resistors and copper conductors on glass substrate in sequence shown (left). Vacuum deposition chamber (at far left in right-hand photo) contains monitor which automatically halts process when resistors reach desired value of resistance. Vacuum tank at right contains experimental ion-beam gun set-up.

ited nichrome transistors with values ranging from five ohms to two megohms, according to Thomas Calhoun who heads the micro-electronics effort within the Aeronautical Division. Value of the deposited resistance can be controlled to better than 10% during substrate deposition by means of a monitor strip. During the process, the substrates and the monitor strip are mounted on a rotating disk so that nichrome is deposited simultaneously on both. Resistance of the monitor strip is continuously measured and the process is halted when it reaches the predetermined value.

Resistors with positive, negative or zero temperature coefficient can be obtained by controlling thickness of the nichrome deposit. In relatively thick films, nichrome exhibits positive temperature coefficient of bulk material, while thin films exhibit negative coefficient. Suitable blend gives essentially a zero temperature coefficient.

Reliability Cited

Calhoun says that company experience to date indicates that the deposited nichrome resistors are fully as reliable as high quality conventional resistors.

During the coming year, Honeywell expects to develop a process for making deposited capacitors in smaller sizes.

The B-58 application required a capacitor with a large capacitance—too large to achieve by deposition, and commercially available tantalum capacitors were too large for the substrate. Although Honeywell had no previous experience in the capacitor field, the Research Division's work in basic materials enabled it to come up with a dry-sintered tantalum capacitor which was significantly smaller than available commercial units. The Aeronautical Division is now producing these units on a model-shop basis, rated at 250 mfd.-volts, which measure only 0.18 in. in diameter by 0.06-in. thick.

Honeywell's Semiconductor Division has developed a number of solid-state circuits fabricated on a common crystal substrate, many of which are expected to be available in prototype quantities by early 1961, according to Nicholas. Typical circuits include a flip-flop, a multi-stage amplifier and a 12-stage diode OR gate.

The diode gate circuit consists of 12 diodes diffused in a circle on a 0.125-in. square N-type silicon die. Each diode measures 0.007 in. in diameter. A signal at any of the 12 inputs will be conducted to the output lead attached to the center of the diode circle without affecting any of the other input circuits. The device is expected to find its first application in an airborne digital computer being developed by Honeywell's inertial guidance facility at St. Petersburg, Fla.

Another solid-state circuit Minneapolis-Honeywell has developed is a direct-coupled two-stage amplifier with common-emitter connection. It consists of two mesa transistors, fabricated on a single crystal, with only an electrical jumper to connect the emitter of one transistor to the base of the other.

An experimental model exhibits a gain of about 1,300 at a collector current of 100 ma., with moderate leakage currents and saturation voltage. The complete two-stage amplifier fits inside a standard TO-5 transistor package.

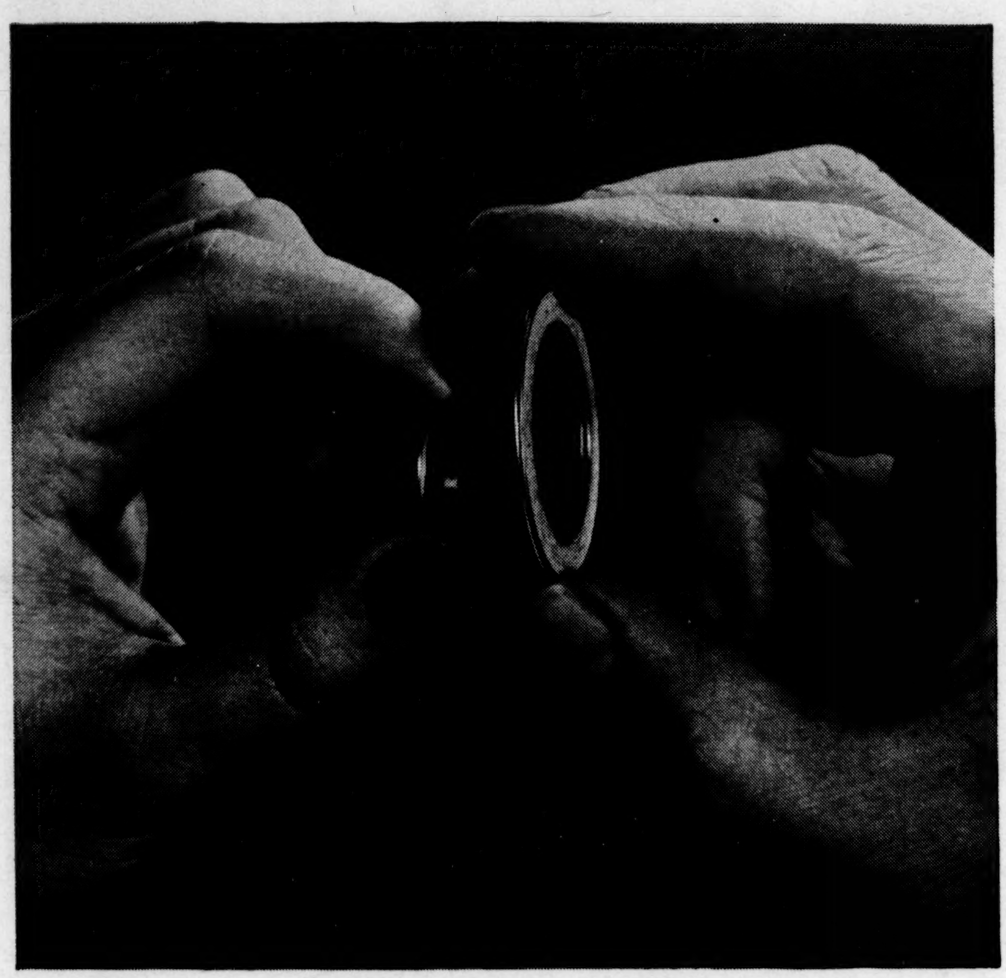
Research Effort

Several examples illustrate the basic type of work under way in Honeywell's Research Division:

- **Rotatable anisotropy thin film,** whose direction of easy magnetization can be changed at room temperature (or below) by the application of a very low magnetic field, in contrast with conventional ferromagnetic thin film which requires annealing at 200C or higher, is one of the company's promising new developments. This rotatable anisotropy film permits fabrication of extremely compact, high-density nondestructive readout type storage for digital computers without attempting to control the direction of easy magnetization until after the matrix is completely fabricated. Company scientists report that they have fabricated 16 x 16 matrices with no more than a 10% variation in tolerances between individual elements in the matrix.

The ability to shift the easy direction of magnetization through the application of a small field suggests the possibility of using the phenomenon for computation as well as for information

GASKETS
in Design Engineering



New, ultra-thin Garlock GUARDIAN* Gaskets solve the problem of high-temperature, limited-space sealing on missile and aircraft exhaust systems, turbines, other equipment.

At last—a spiral-wound gasket no thicker than a wedding ring! Ideal for limited space or light flange applications, this new Garlock GUARDIAN Spiral-Wound Gasket is available in thicknesses as small as 1/16″ in gaskets up to 6″ I.D., maximum flange width 3/8″.

Controlled density affords more positive seal. During manufacture of the new "wedding ring" GUARDIAN Gasket, the proper selected thickness of filler material and preformed metal, the number of laminations of filler and metal, and the correct tension of filler and metal while being formed into a gasket are the factors engineered to achieve proper gasket density. By controlling and varying these factors, Garlock is able to match the density to the pressure range. This built-in quality is constantly checked by a Baldwin-Lima-Hamilton compression-testing machine, thereby assuring perfect sealing regardless of the pressure.

High-temperature, high-strength construction. This new Garlock "wedding ring" GUARDIAN Gasket operates effectively at temperatures as high as +1900°F and pressures to 2500 p.s.i. or more. It is an excellent gasket where recycling temperatures are encountered. In the 700°F to 1200°F range, Garlock uses a compressed asbestos filler with stainless steel plies; in the 1200°F to 1900°F range, a ceramic filler is used with several different types of metal plies, depending on customer preference. The ceramic is non-flammable, completely inorganic, and an outstanding chemical insulator. It resists mold, mildew, and aging, thereby allowing indefinite shelf life.

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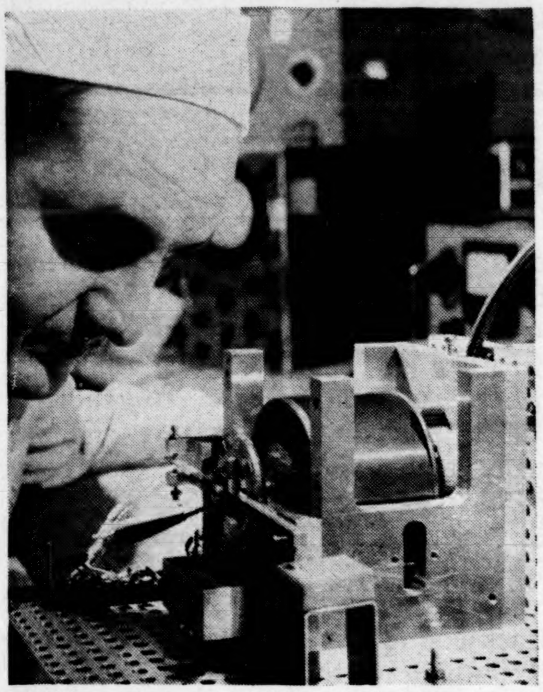


Miniature Memory Drum

Miniature memory drum, using air-suspension bearings, can store 358,000 bits of information on an 8-lb. aluminum sphere. Developed by Sperry Gyroscope Co., device employs read-write heads which float on thin film of air above drum's surface. Drum rotates at 10,000 rpm.

storage. Another possibility suggested by Honeywell scientists is to use polarized light as a readout means for information stored in the film.

- **Large area solar cells,** made from thin film deposition of polycrystalline silicon instead of single-crystal silicon, are under investigation as a means of reducing the cost of solar converters. Experimental units, made by diffusing P-type impurity and then N-type impurity into a film of polycrystalline silicon deposited on a substrate, have exhibited open circuit voltages of 0.3 v., compared with 0.5 v. for conventional solar cells. Conversion efficiency is about 1%, considerably lower than the 10-14% now obtained with single-crystal cells. However, Honeywell scientists point out that they already have increased conversion efficiency by a factor of 100 from the first units made, and believe it can be pushed up still higher. One means of doing this, now under investigation, is to control grazing angle at which films condense on the substrate to provide a crystallite orientation which greatly enhances the photovoltaic effect.
- **Electrical properties** of semiconductor films are under intensive investigation as part of Honeywell's goal of developing techniques for depositing single-crystal semiconductor films on inert substrates. Once this can be done, the way is open to producing complete thin-film circuits, including active elements, by deposition processes. One typical study is the investigation of the sorption of gases by a semiconductor film and the resultant effect on its electrical properties, such as carrier concentration and mobility. In one experiment, using a film of lead telluride, Honeywell scientists found that exposure to oxygen caused the semiconductor's initial conductivity to decrease sharply with time, then it begins to climb.

After a week's exposure, conductivity had returned to its original value and was still increasing.

There presently is no proven technique for depositing a single crystal film of silicon on an inert substrate, although a number of approaches are under study or investigation.

One of the more promising techniques, according to Honeywell, is to deposit a polycrystalline film, by vapor plating or vacuum deposition, and then to use an electron beam to heat the surface locally until it becomes a monocrystal, grown in place parallel to the substrate. A similar technique, using a molecular beam, would involve plating edgewise on the film, making it possible to "write" single crystal elements on an inactive substrate by controlling the position of the ion beam.

Using the rotatable anisotropy films, Honeywell scientists say it should be possible to produce a non-destructive readout type memory, with a capacity of one million bits, in a cube measuring 2 to 4 in. per side. However, this high-density packaging will raise internal cooling problems.

One possible solution under consideration by Honeywell is the use of thin-film Peltier (thermoelectric) cooling to transfer internal heat to an external heat exchanger.

Battle Display Console

Navy display console for showing status of battle situation includes air, sea-surface and submarine warfare. Old manual grease-pencil plotting board which it is expected to replace is shown behind. Display console, developed by Hughes Aircraft Co., is part of new Navy Tactical Data System (NTDS), now being readied for service test.

Vanguards to Get Collins Autopilot

Collins AP-103 automatic pilot has been approved by British Air Registration Board for use on the Trans-Canada Airlines fleet of Vickers Vanguard turboprop-powered transports. Approval came eight weeks from time of initial installation of the autopilot on a Vanguard and following less than 30 hr. flight test time by Vickers.

Initial operational Vanguard was delivered to TCA in December, 1960. The TCA Vanguards also are fitted with Collins FD-105 flight director system and a complete Collins communications and navigation system, including the DF202 automatic direction finder, 51X-2 VHF receiver, 17L7 VHF transmitter and 344B-1 VOR instrumentation unit.

FILTER CENTER

▶**Sperry Boosts ECM Tube Power**—A traveling wave tube, capable of generating 3,000 watts output at X-band, has been developed by Sperry Gyroscope Co. using a liquid-cooled tube helix. Same tube built with conventional solid wire helix conductor could produce only 50 watts, company says. The stainless steel helix tube has an inside diameter of 0.019 in. and a wall thickness of 0.006 in. Company has experimented with both water and a special fluorocarbon, capable of operating over temperature range of −76 to 842F, as coolants.

▶**Navy Launches Avionics Checkout Program**—P. R. D. Electronics will make a basic engineering study on automatic checkout systems for avionics equipment, under new contract from Navy Bureau of Weapons. Project name is NavSea, an acronym from Naval Avionics Support Equipment Appraisal.

▶**Solid State Curriculum Established**—Pennsylvania State University has established a graduate inter-disciplinary curriculum leading to M.S. and Ph.D. degrees in Solid State Technology. Candidates will be accepted beginning with the 1961-62 school year. Information on the program can be obtained from the Dean of the Graduate School, Pennsylvania State University, University Park, Pa.

▶**IRC Enters Semiconductor Field**—International Resistance Co., a major supplier of resistors, has purchased controlling interest in North American Electronics, Inc., Lynn, Mass., which produces silicon rectifiers and Zener diodes.

Angle-of-Attack System Proposed for Jets

By Barry Tully

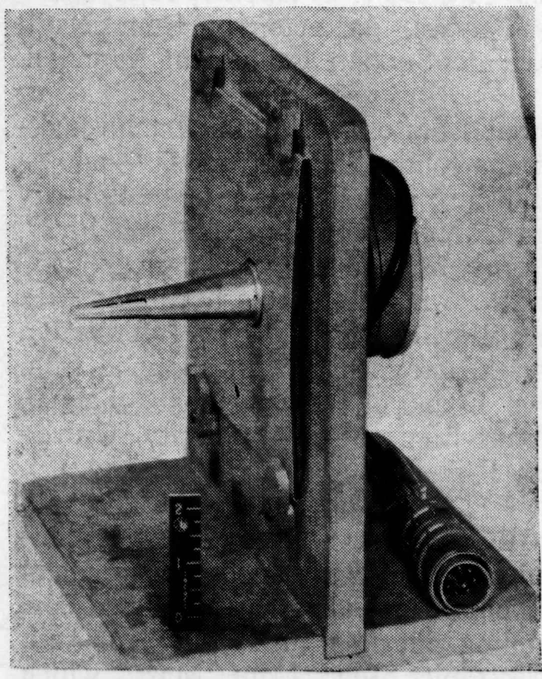
Syosset, N. Y.—Standardization of jet transport takeoffs, climbs, approaches and holding maneuvers is proposed by means of an angle-of-attack instrument and a relatively lag-free vertical speed indicator.

The angle of attack of a wing configuration, being constant for best lift/drag ratios regardless of airspeed, gross weight, bank angle, g loading and other variables, is sensed in flight tests and is even measured as part of the flight instruments of many jet transports. Thus, a pilot should have at his disposal an instrument which, with automatic flap position compensation, can present best climb rate (or angle), optimum approach speed, and maximum safe bank angle when holding at low airspeeds—all without adjusting for gross weight, ambient air pressure, etc.

Difficulty Cited

The difficulty in all this is in presenting the angle-of-attack information to the pilot so that it can be used for flight control. Angle of attack in a large aircraft changes slowly, making an indicator sensing this change relatively ineffective as a flight control instrument.

Specialties, Inc., Syosset, N. Y., maker of angle-of-attack instruments for Navy jet fighters, has developed a system which is said to provide the necessary anticipation of angle-of-attack change by means of its inertial-lead vertical speed indicator. This instrument, standard on some airlines, combines pressure sensing with accelerometer signals to eliminate much of the inherent lag in the pressure sensing device.



AIRSTREAM direction detector is mounted on side of fuselage to sense angle of attack.

The company has proposed flight testing of its system by the Federal Aviation Agency to be conducted at the Bureau of Research and Development, Atlantic City, N. J. Use of the Specialties angle-of-attack system, as proposed by the company, calls for establishment of correct angle of attack by means of the angle-of-attack indicator and maintenance of the stabilized climb (or descent) by means of the vertical speed instrument.

In addition to in-flight measurements, Specialities says that its angle-of-attack instrument can be used to determine optimum rotation attitude upon reaching V_R on takeoff roll. The angle-of-attack instrument will not sense takeoff speed; however, with the wings unloaded on a level runway, it will indicate best rotation attitude which is constant for a given aircraft configuration.

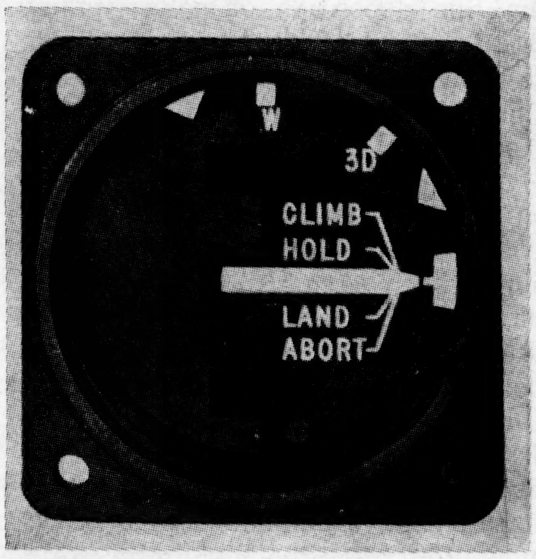
The angle-of-attack system developed by Specialties, Inc., consists of five components:

- **Airstream direction detector,** a conical probe, is mounted in a non-turbulent airstream at the side of the fuselage. The null-balancing angle-of-attack sensor measures an angle of attack about 1.5 times as large as the wing angle of attack. This is dependably repeatable and is used to increase the resolution of the system.
- **Trimming unit** contains trimming potentiometers to adjust the system to a particular aircraft design.
- **Flap position compensator** is connected directly to the flaps and electrically compensates the indicators to correspond with angle-of-attack change with varying flap angles. Thus, if the flaps are inadvertently set wrong, the indicator will still indicate best angle of attack for that configuration.
- **Angle-of-attack indicator** mounted on the pilot's instrument panel may be calibrated in "units" of angle of attack and may just mark the positions of particular flight situations. Specialties recommends placing the angle-of-attack indicator next to the airspeed indicator.
- **Approach index,** mounted on the instrument panel glare shield, provides an enlarged scale angle-of-attack reference within the pilot's peripheral vision on final approach.

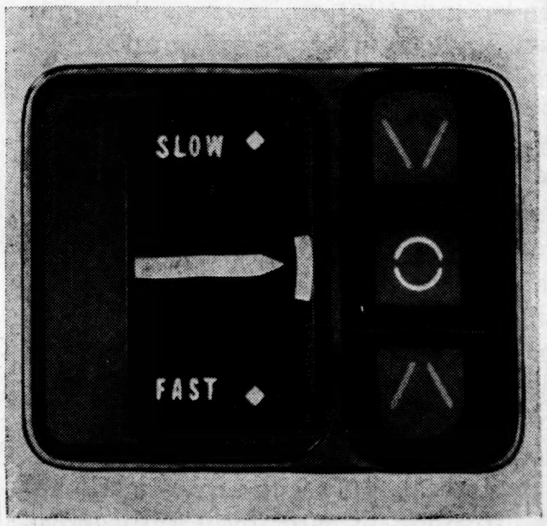
The angle-of-attack presentation suggested for air transport operation presents optimum angle of attack for standard flight modes at the 3 o'clock position on the indicator dial. As angle of attack is increased, the pointer moves counter-clockwise to the 9 o'clock position, representing stalling angle of attack. Intermediate positions are marked for special flight modes such as three engines wet and three engines dry.

Specialties, Inc., says that angle-of-attack control, by eliminating the need to compute reference airspeed, can provide, with five indicator positions, what now must be gleaned from 28 pages of operating manual procedure. Included among the normal and emergency conditions which may be controlled by means of the angle-of-attack indicator are takeoff rotation attitude, single engine failure on takeoff wet and dry, best climb with four engines and en route climb with one or two engines out.

En route, with four engines operating, cruise climb is flown at constant Mach. Other flight modes served by



INDICATOR shows best angle of attack for both normal and emergency flight modes.



APPROACH index presents angle-of-attack information on final approach speed.

the angle-of-attack indicator include maximum endurance, missed approaches with either 30 deg. or 50 deg. of flap, maneuver limit and stall.

During holding at reduced airspeeds, the indicator should prove useful in that as buffet (and stall) bank angle decrease with airspeed, the indicated angle of attack remains constant.

The approach index provides a visual angle-of-attack reference while the pilot is looking at the runway. This indicator mounted on the instrument glare shield represents a scale enlargement of the panel-mounted angle-of-attack indicator. Presented with "fast" (low angle of attack) and "slow" (high angle of attack) readings, the approach indicator also incorporates three red lights for increased conspicuity. These three lights, mounted vertically, light singly or in pairs to provide five indications which may be interpreted by the pilot as "very slow, slow, on speed, fast, very fast."

Designed to give the pilot angle-of-attack information during the visual contact phase of an instrument approach and throughout a normal approach, the approach is mounted on the glare shield within the pilot's peripheral vision.

The idea is to provide a sensitive angle-of-attack index and to display it in a manner that will lessen the amount of head bobbing as the pilot divides his attention between the runway and the instrument panel.

Stumbling Block

Specialties, Inc., insists that a major stumbling block in the path of angle-of-attack indicator acceptance is confusion on the part of many pilots between angle of attack (angle formed by the relative wind and the wing chord) and the aircraft nose attitude. Additionally, the fact that even those who know the difference have had to seek the best angle of attack by means of speed indicators (which are subject to variation) and attitude gyros.

Pilots are reluctant to leave the airspeed indicator with its known deficiencies for an unknown (and often misunderstood) quantity. Thus, pilots often prefer to compute reference airspeed rather than place their confidence in a new dial. In this respect, a "fast—slow" speed indication, although not always correct from an aerodynamic standpoint, seems to have advantages in the area of human factors.

The first broad acceptance of angle-of-attack flight instruments has been by the Navy. The need for an angle-of-attack indicator was first recognized in connection with catapulting jets during aircraft carrier operations. In catapulting jets, with power and flaps set, wind conditions often marginal and an absolute altitude of about 70 ft., failure to find best lift/drag angle of attack with alacrity would often result in quick ditching. Night operations with little or no real horizon compound the problem.

Installation of angle-of-attack instruments on the Navy jets proved to be of value after considerable pilot education as to the use of the instrument. The angle-of-attack indicator's independence of gross weight, pressure levels and other variables proved valuable not only on catapult takeoff but on landing approach both at sea and on land. Another area where the instrument is used is in pulling steep turns at altitude.

In this instance the instrument warns the pilot when steep turn stalls are neared.

Throttle Control

Specialties says that the Navy rigged an automatic throttle control to its angle-of-attack sensor after experiencing marginal results with airspeed sensing. The test aircraft, a Chance Vought F8U fighter, was flown through an approach with the throttle controlled by the angle-of-attack sensor. The test data tapes showed that the plane was held within one knot of planned approach airspeed. This suggests that angle-of-attack instruments could be used for throttle control on automatic instrument landing systems. Most systems now under test sense airspeed to control power.

The Federal Aviation Agency is studying Specialties, Inc.'s, proposal to evaluate angle-of-attack measuring systems with the idea of establishing standards for angle-of-attack systems if they are deemed valuable in jet transports.

The proposed flight evaluation of the angle-of-attack instrument will be conducted with a Grumman F9F-8T fighter equipped with a standard Navy angle-of-attack instrument. Simulation of power-to-weight ratios comparable to jet transports will require flying the aircraft at high gross weights and at thrust levels reduced consistent with safety.

In-Flight Tests

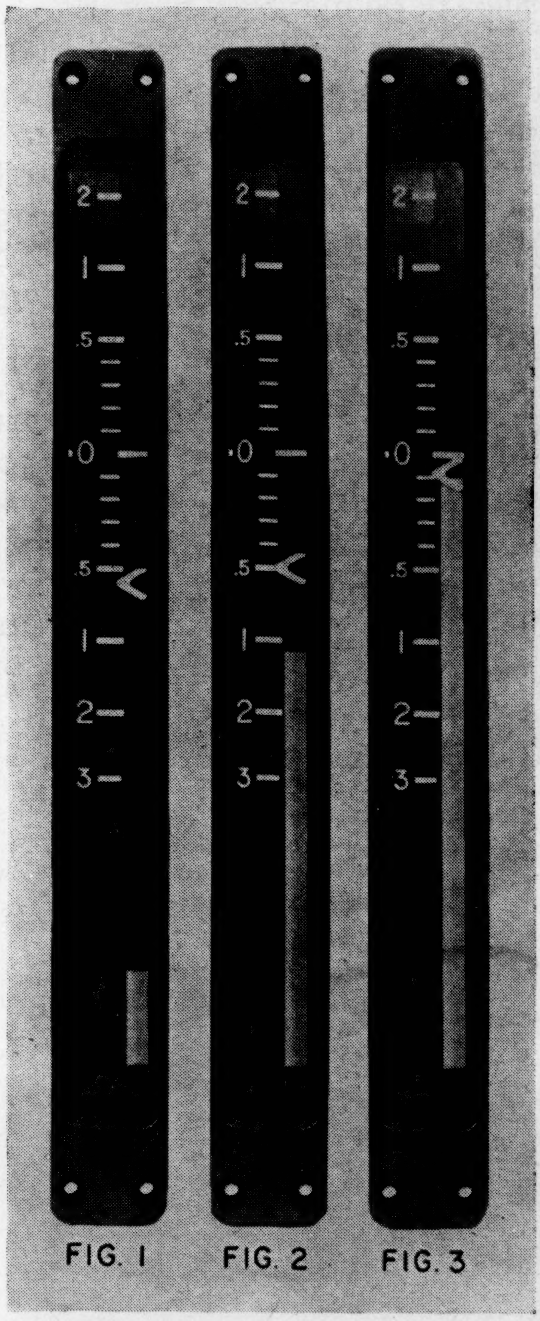
The test aircraft would be fitted with the inertial-lead vertical speed indicator, produced by Specialties, Inc., to stabilize climb-out paths. With the plane stabilized at best climb angle of attack, any gradual departure from that angle would be first noted on the vertical speed indicator.

The two-place F9F-8T will permit the crew to simulate airline procedures in that the rear cockpit crewman can call out precomputed V_R speed. Data to be recorded automatically in flight would include angel of attack, altitude, airspeed, normal acceleration, elevator movements and time.

WADD Tests Cockpit Landing Instrument

New York—A cockpit landing instrument displaying height above ground and instantaneous vertical speed for automatic landings will be test-flown at Wright Air Development Division in Lockheed T-33 and Convair C-131 aircraft.

The vertical tape display instrument, which operates from AN/APN-22 radar altimeter inputs, is being evaluated by WADD's Flight Control Laboratory for inclusion in an all-weather landing program being conducted jointly by WADD and the Federal Aviation Agency. The Instrument Division of Lear, Inc., Grand Rapids, Mich., de-



SEQUENCE PHOTOS show the Lear all-weather landing indicator during a typical landing approach and flareout. At left, the instrument shows the aircraft descending at about 600 fpm.; vertical tape visible at bottom indicates plane has passed through 200 ft. absolute altitude. Center photo shows continued descent toward the runway and a slowing to 500 fpm. At right, landing flare-out is indicated by the pointer indicating 80 fpm. sink rate and tape indicator showing the aircraft just off the runway surface.

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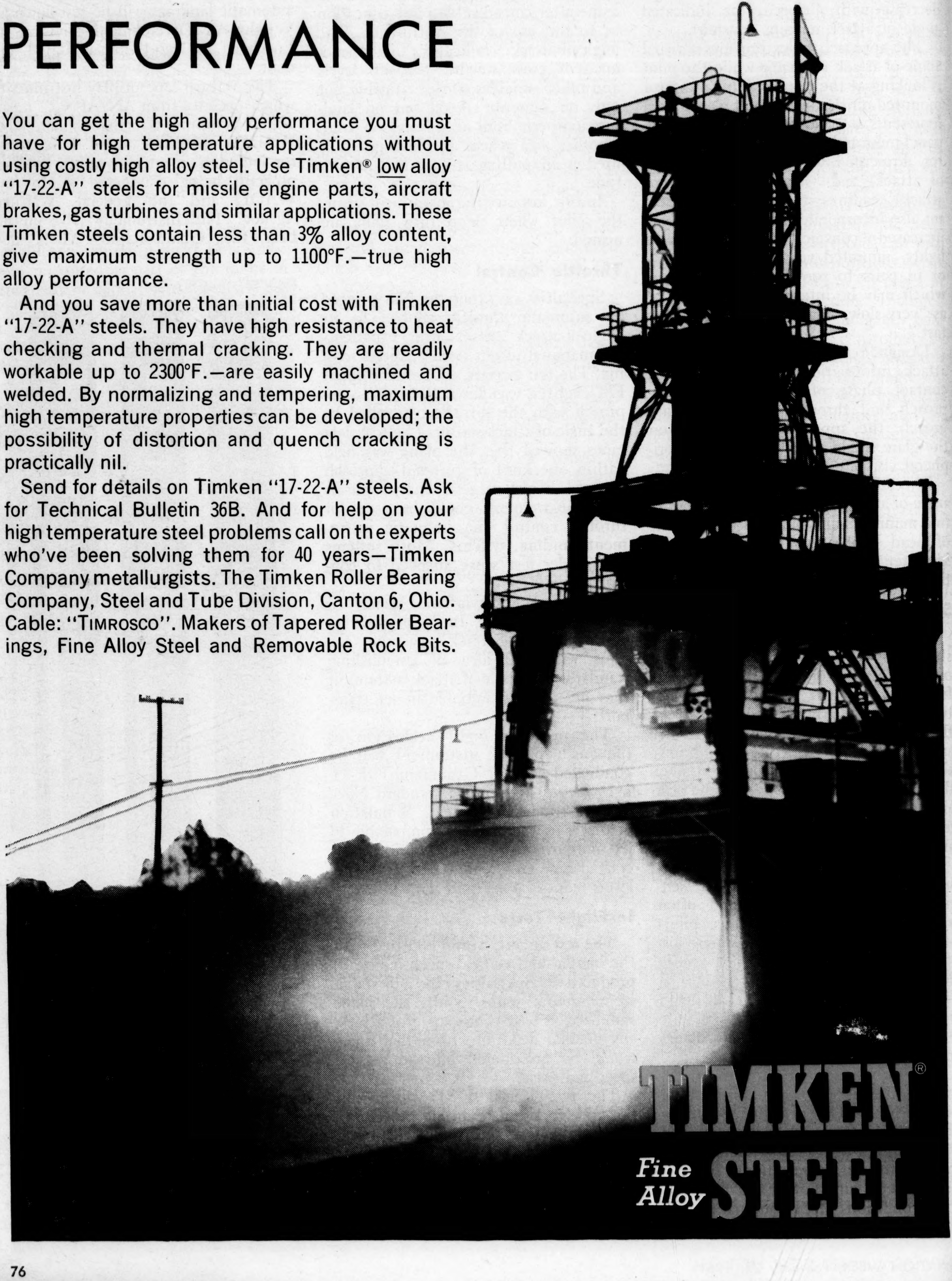

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veloped the instrument and has delivered three to the Flight Control Laboratory for evaluation.

The absolute altitude/vertical speed indicator will give pilots both rate-of-descent and a runway closure indication. In an automatic landing in "zero-zero" conditions, the instrument would provide an instantaneous indication of an excessive sink rate or of any tendency to float down the runway prior to touchdown. The instrument may also be of value on heavy jet aircraft which are at a steady rate of descent. Here the instantaneous reaction of the avionic instrument and its independence of changes in barometric conditions would be advantageous.

The landing indicator displays absolute altitude by means of a bright orange moving tape on the right of the inch-wide display. At an absolute altitude of 200 ft., the tape appears at the bottom of the scale and moves upward toward a zero reading as the aircraft descends. Vertical speed is indicated in either climb or dive by a pointer read against a scale. The indicator records vertical speeds from zero to 40,000 fpm. Between 40,000 and 3,000 fpm. a pointer fixed beside a window points toward a tape displaying vertical rates in thousands of feet. At rates less than 3,000 fpm. the pointer moves against the fixed vertical scale.

The indicator provides height above the surface in addition to programed indication showing the aircraft's final descent, flareout and touchdown. Altitude shown by the orange tape is a general indication in relation to a specific vertical speed readout. Since rate of altitude closure is directly associated with change in vertical speed, the movement of the altitude tape and rate of descent pointer follows the desired asymptotic flareout. The relative positions of the two give the pilot a visual indication of his height and movement in relation to the ground.

The instrument, designed to be incorporated in integrated panel displays, is 1-in. wide, 10-in. high and 8-in. deep. Lear developed a dry powder clutch measuring 0.6 in. in diameter and 0.8 in. in length to fit the narrow instrument. The clutch provides a frequency response over 100 cps.

Initial testing of the landing instrument was conducted with a T-38 flight simulator. Tests were used to determine whether pilots could make a smooth descent, flareout and touchdown using the landing instrument. Flight tests will determine the instrument's usefulness in an actual aircraft.

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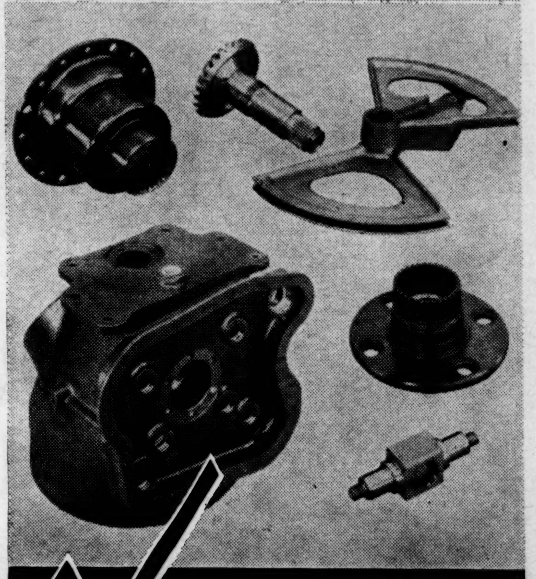

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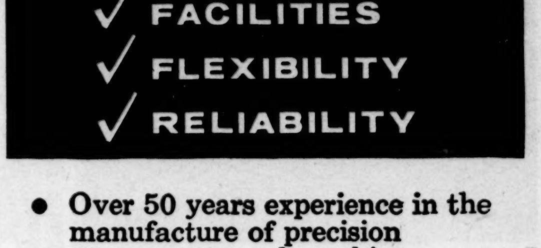
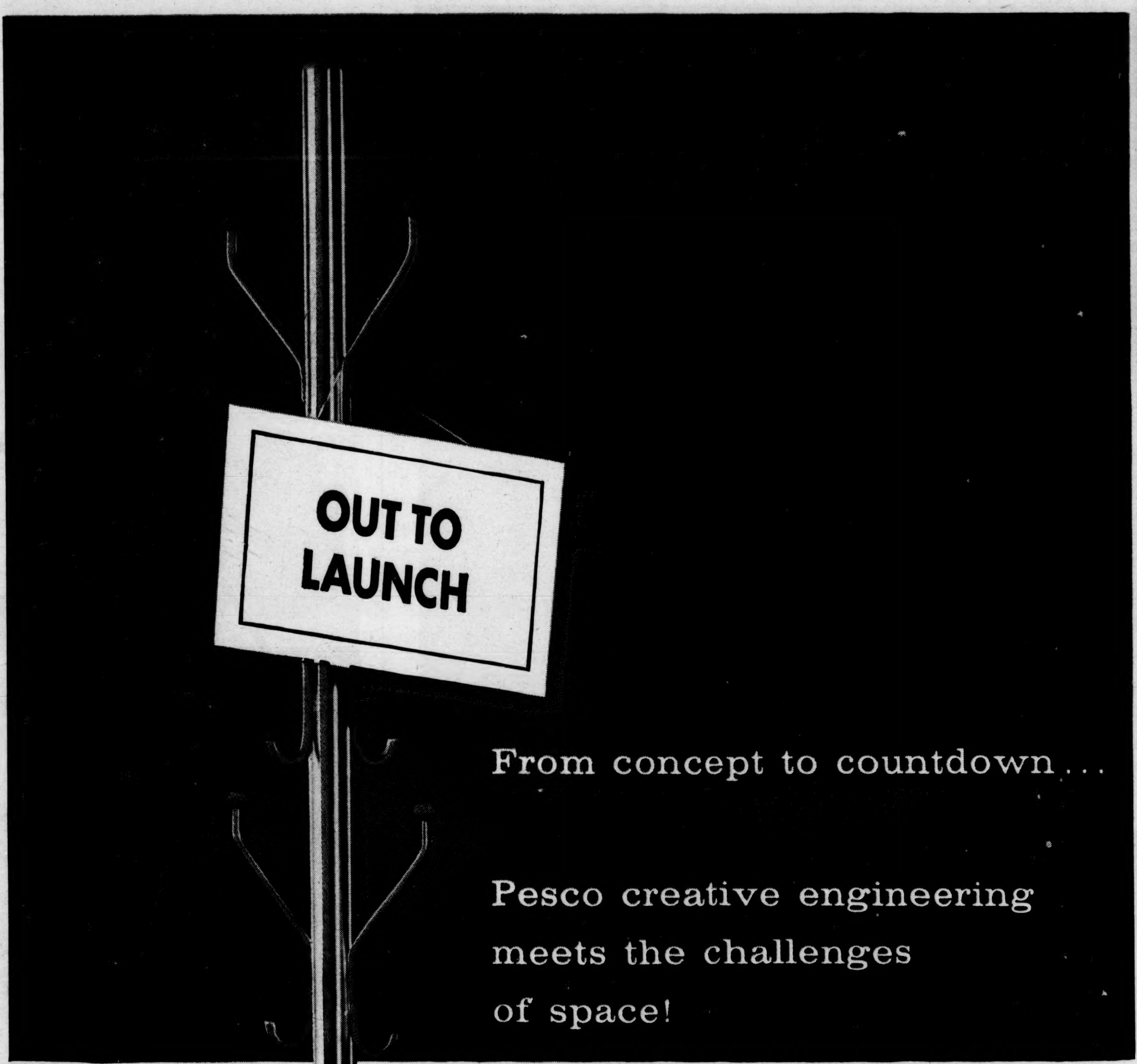
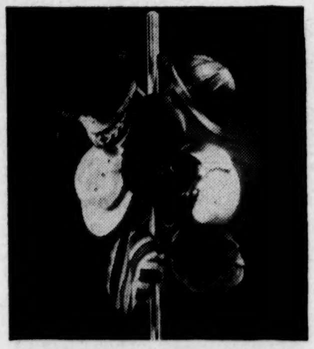
- **Write for Facilities Folder. The Fenn Manufacturing Company, Fenn Road, Newington, Connecticut.**





9087-PC

Imaginative concepts are translated into reality at Pesco . . . where engineering ingenuity combines with production proficiency to create specialized components for the aerospace industry. And Pesco extends its total engineering capabilities through a close working relationship with the Borg-Warner Research Center! Advanced design principles to meet tomorrow's needs are embodied in many Pesco products now specified for an impressive list of operational air vehicles. Current projects include electronic and hydraulic power packages, environmental cooling systems, cryogenic pumps . . . plus research programs in electrical control actuation, thermo-electric infra-red sensor cooling and thermo-electric power generation. Write today for information about Pesco's integrated design-and-build capabilities.



THE 7 HATS OF BORG-WARNER

(top) national defense; oil, steel and chemicals; (middle) agriculture; industrial machinery; aviation; (bottom) automotive industry; home equipment.

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SOLID propellant cartridges are loaded into breech assembly for test firing.

Small Turbine Starter Cartridges Developed

McGregor, Tex. – Solid-propellant cartridge, weighing only 11 lb., has been developed for quick starts of aircraft turbine engines. Starter cartridge utilizes a clean, cool-burning propellant and has been tested successfully through a temperature range of −75F to 170F.

Measuring approximately eight inches long by six inches in diameter, the cartridges produce 430 gas horsepower for 17 sec. In operation, the units would be installed in a special starter breech on the aircraft, the pilot would ignite the unit and the gas stream would spin a small starting turbine, which, acting through a gear train, would spin the jet engine turbine.

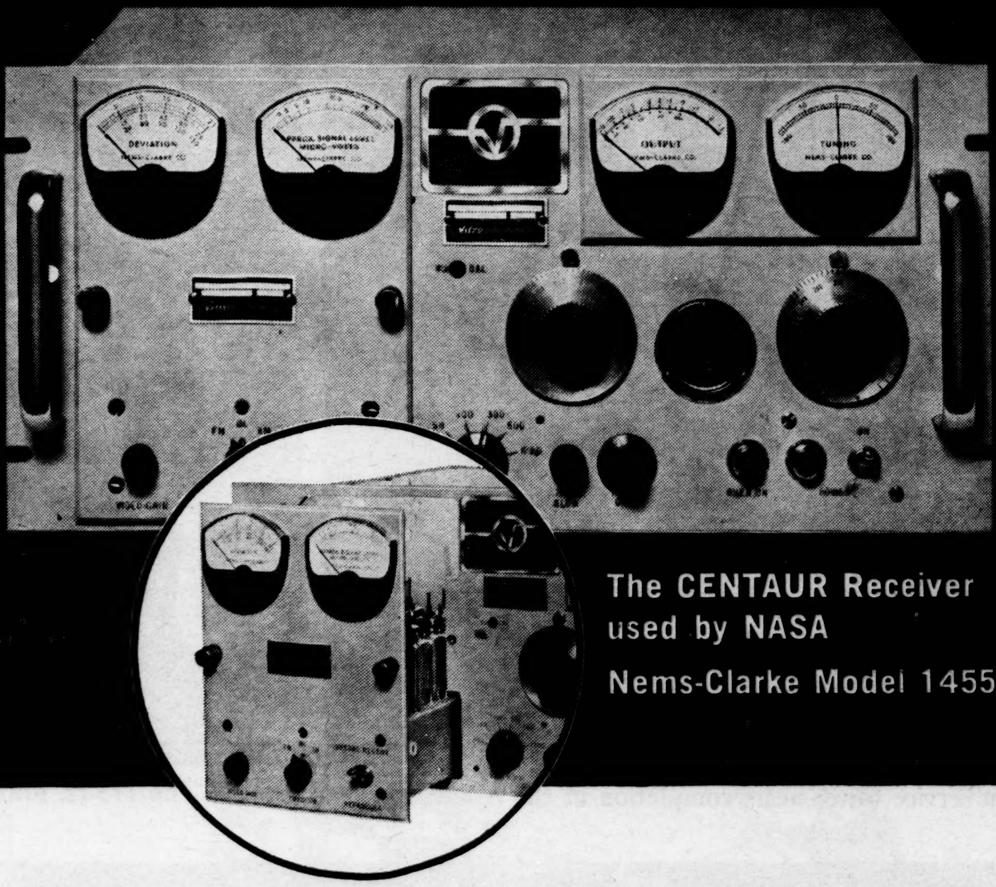
Propellant grain is designed to burn internally to eliminate weight of extra insulation and to minimize external temperatures on the cartridge breech during firing.

Unit has been designed and built by North American Aviation Rocketdyne Solid Propulsion Operations.

Fuel Safety System Developed for B-70

A nitrogen inerting system for the North American B-70 fuel tanks has been delivered to North American Aviation by the system's developers, the Parker Aircraft Co. and Arthur D. Little, Inc.

Designed to prevent auto-ignition in the fuel tanks because of high temperatures developed at Mach 3, the system maintains a preselected nitrogen pressure and atmosphere in the fuel system. Nitrogen, carried in liquid form, is converted to gaseous form and automatically vented to the tanks by a pressure-sequenced servo system. Pipes, tubes and fittings are eliminated in the system and are replaced by integral passages in a manifold to which valves are attached.



MODULAR TELEMETRY RECEIVER FEATURES MULTIPLE BANDWIDTH SELECTION

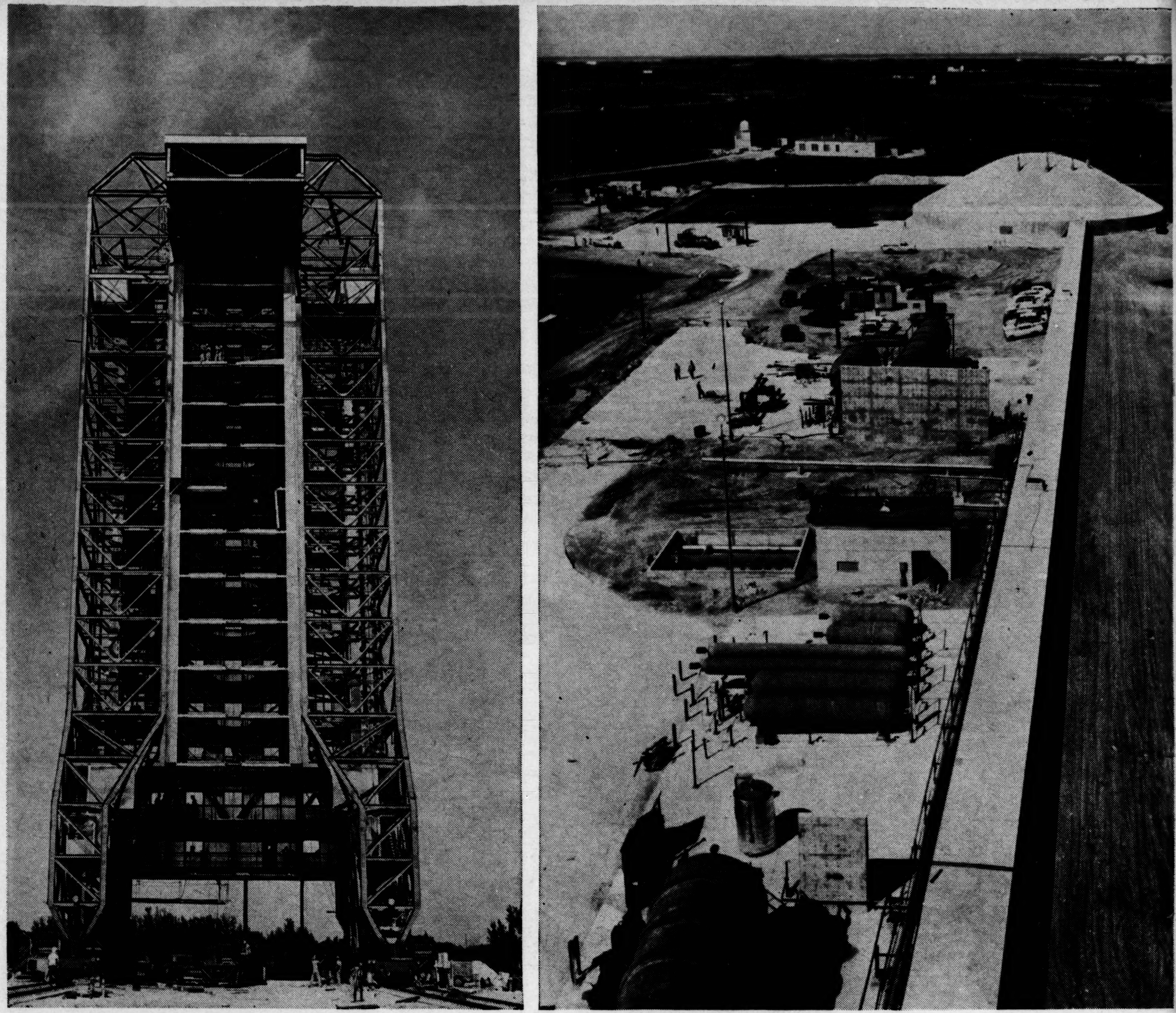
The CENTAUR Receiver used by NASA
Nems-Clarke Model 1455

Designed to provide a selectable bandwidth capability for PCM, the 1455 most nearly approximates a "universal" telemetry receiver. IF/Demodulator Modules are available in bandwidths ranging from 100 KC to 1.5 MC. Each module contains 3 independent demodulators. Selectable by a front panel switch, they are: Foster-Seeley Discriminator, Phase-Lock Detector, and AM envelope detector. As a further refinement in signal-to-noise ratio enhancement, the video amplifier incorporates a video bandwidth filter having a 6 db per octave roll-off adjustable from 20 KC to 1.2 MC by means of a front panel switch. This receiver is capable of **optimum** reception of any known type of telemetry signal. Features: 5 MC pre-detection recording output, playback input terminals, and integral VFO, automatically actuated by a micro-switch on the crystal socket. The modulation sensitivity and deviation meter scales provide output voltages and meter deflections which are essentially the same percentage of bandwidth in all modules.

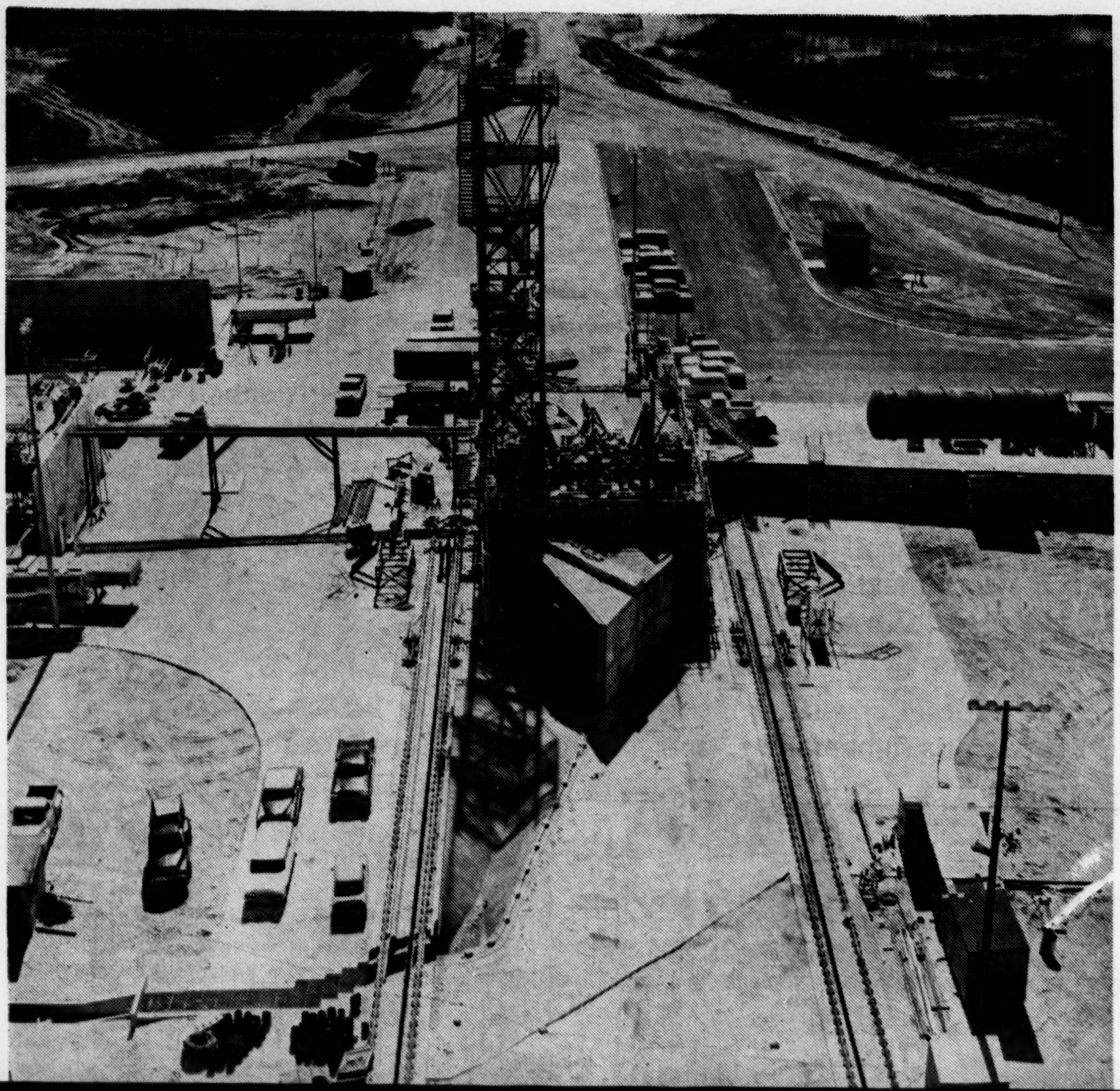
Available as an accessory unit is the Nems-Clarke IFC 1400 Pre-Detection Converter which permits use of the 1455 with stationary-head instrumentation tape recorders for pre-detection recording.

See the 1455 Receiver at the I.R.E. Show, Booths 3917-3919.

Vitro ELECTRONICS A DIVISION OF VITRO CORPORATION OF AMERICA
PRODUCERS OF NEMS-CLARKE EQUIPMENT
919 JESUP-BLAIR DRIVE, SILVER SPRING, MARYLAND / 2301 PONTIUS AVENUE, LOS ANGELES 64, CALIFORNIA



Centaur service tower nears completion at the Atlantic Missile Range. The 173-ft. tower, pad and blockhouse constitute Complex 36.



Atlas-Centaur Tower Nears Completion

Atlantic Missile Range's Complex 36 is being prepared for an Atlas-Centaur space vehicle launch this summer. The Centaur is a Convair Division-National Aeronautics and Space Administration project. The Centaur tower is 58 ft. higher than the Atlas ICBM launching tower at Complex 11. The tower sits on 16 railroad-type wheels mounted on tracks. A hydraulically-powered rack and pinion system moves the gantry in contrast to the electric propulsion system utilized in the Atlas complexes. A permanent 70-ft. umbilical tower on the elevated launch pad is topped by two hydraulically actuated booms which carry fuel, power and instrumentation lines to the upper stages. The 75-ft.-dia. x 38½-ft. high blockhouse is covered by 5-ft. thick reinforced concrete, topped by packed sand. The blockhouse is built on two levels. Top level contains control consoles and a glass enclosed booth for visitors. Lower level is utilized for launch service equipment and a crew-ready room.

Stock Transactions

Current trend of inside trading in the aerospace industry seems to have shifted to the buying side; note the acquisition of stock through the exercise of large options. There could be a number of reasons: lower prices of many stocks making them more attractive buys; feeling that outlook for business has improved; issuance of new options, etc.

The following transactions for the period Sept. 11 to Nov. 10, 1960, have been reported by the Securities and Exchange Commission.

Aerojet-General Corp. Acquisition of 150 common shares by William L. Gore, officer, making a holding of 265 (indirect holding in partnership remains 58).

Aeronca Manufacturing Corp. Acquisition of 200 common shares by George M. Ebert, officer, making a holding of 900.

Allegheny Airlines. Acquisition of $10,000 of 6¼% convertible debentures by Robert F. George, director, making a holding of $85,000.

American Bosch Arma Corp. Acquisition of 250 common shares through exercise of option and disposition of 500 common shares by W. G. Tuttle, officer, leaving a holding of 1,500; disposition of 22 common shares, his total holding, by William Stix Wasserman, director, plus disposition of 1,500 common shares, his total holding held indirectly in Investment Corp. of Philadelphia, and disposition of 3,679 common shares held indirectly in trusts, leaving an indirect holding in trusts of 600.

Bendix Corp. Acquisition of 527 common shares by A. P. Fontaine, officer and director, making a holding of 1,182; acquisition of 500 common shares by Charles Tillinghast, Jr., officer, making a holding of 501.

Boeing Airplane Co. Acquisition of 100 common shares by Evan M. Nelsen, officer, making a holding of 1,873.

Cessna Aircraft Co. Acquisition of 5,416 common shares by F. A. Boettger, officer and director, making a holding of 27,141; acquisition of 4,200 common shares by Robert L. Lair, officer, making a holding of 5,100; acquisition of 3,191 common shares by Thomas B. Salter, officer and director, making a holding of 17,046; acquisition of 25,650 common shares by Dwane L. Wallace, officer, making a holding of 159,207.

Eastern Air Lines, Inc. Disposition of 225 common shares by John A. Hamill, Jr., officer, leaving a holding of 15.

Electronic Communications. Acquisition of 501 common shares by Lorian W. Willey, officer, making a holding of 600.

Fairchild Camera & Instrument Corp. Acquisition of 500 common shares by Kenneth P. McNaughton, officer, making a holding of 1,020.

Fairchild Engine & Airplane Corp. Disposition of 100 common shares, his total holding, by Roger H. B. Davis, officer.

Garrett Corp. Acquisition of 500 common shares by W. R. Ramsaur, officer and director, making a holding of 6,487.

General Tire & Rubber Co. Acquisition of 1,000 common shares through exercise of option by Dan A. Kimball, officer and director, making a holding of 6,029; acquisition of 1,623 common shares by L. A. McQueen, officer and director, making a holding of 13,683; acquisition of 2,161 common shares by Arthur H. Rude, director, making a holding of 2,501.

Giannini Controls Corp. Acquisition of 706 common shares, through conversion, and disposition of 106 common shares by Frederick F. Robinson, director, leaving a holding of 1,500, and disposition of 500 preferred shares, his total holding, by conversion.

Hercules Powder Co. Disposition of 250 common shares by Wyly M. Billing, officer and director, leaving a holding of 5,603; acquisition of 6,750 common shares through exercise of option by Albert E. Forster, officer and director, making a holding of 10,649; disposition of 2,000 common shares by Edward B. Morrow, officer and director, leaving a holding of 851.

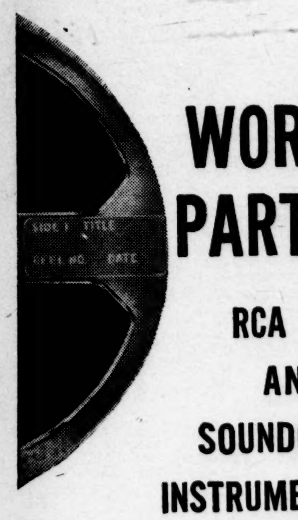
Hycon Mfg. Co. Acquisition of 22,500 common shares, owned indirectly, by Trevor Gardner, officer and director, making a holding of 22,500.

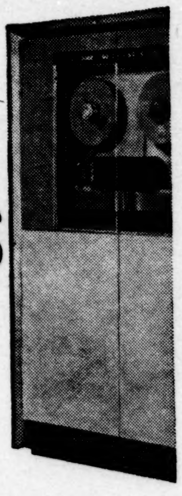
Lear, Inc. Acquisition of 11,200 common shares by William P. Lear, director and beneficial owner, making a holding of 462,261; disposition of 381 common shares, his total holding, by Glen C. Warman, officer.

Lionel Corp. Acquisition of $10,000 of 5½% convertible subordinated debentures through exercise of rights by John B. Medaris, officer and director, making a holding of $10,000.

Lionel Corp. Acquisition of 9,500 common shares through exercise of option by Roy M. Cohn, director, making a holding of 40,000 (indirect holdings remain 1,810); acquisition of 8,000 common shares through exercise of option by Alan Ginsburg, officer, making a holding of 11,800; acquisition of 2,000 common shares by John B. Medaris, officer and director, making a holding of 2,100; acquisition of 100 common shares by George E. Sokolsky, director, making a holding of 600.

Litton Industries, Inc. Disposition of 2,500 common shares by Roy L. Ash, officer and director, leaving a holding of 116,643 (indirect holdings remain 16,232); acquisition of 3,300 common shares by W. P. Corderman, officer, making a holding of 4,100; acquisition of 10,000 common shares by Glenn McDaniel, officer and director, making a holding of 28,000; acquisition of 6,400 common shares by Russell W. McFall, officer, making a holding of 8,052; acquisition of 1,500 common shares by William E. McKenna, officer, making a holding of 2,519; disposition of 3,075 common shares by Norman H. Moore, officer, leaving a





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TAPES

For many corporations, the heart of their data handling operation will be the new RCA 501 Computer System. Soundcraft Tape proved to be the perfect working partner for the "501"—not only in the crucial testing of the computer, but afterward, in continuous working use.

Experience has proven that Soundcraft works best on leading computer systems, like the RCA 501. Why not let Soundcraft Instrumentation Tapes go to work for you. Complete literature on request.

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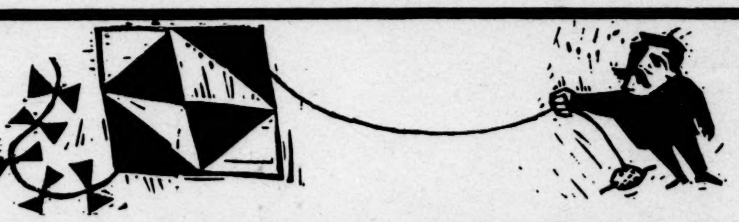
PROBLEMATICAL RECREATIONS 55



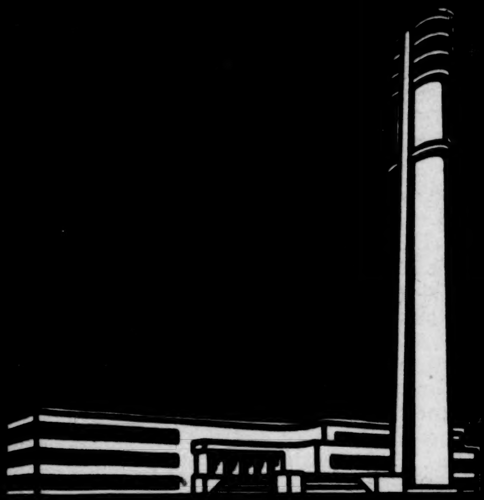
The faces of a solid figure are all triangles. The figure has nine vertices. At each of six of these vertices, four faces meet, and at each of the other three vertices, six faces meet. How many faces does the figure have?
—Contributed

No less than 204,000 square feet is the total space for research, development and production of microwave tubes and display devices at our Electron Tube Division in San Carlos, California, after addition of two new buildings. One of the buildings is supplied with 3.2 million watts of power for testing. The new facilities cost more than $1.5 million and will house special instruments for assembling and testing large klystrons such as those used in the ballistic missile early warning system.

ANSWER TO LAST WEEK'S PROBLEM: First calculate the times at which the minute and hour hands are exactly 120 degrees or ⅓ circle apart. Then calculate the position of the second hand at these times, and choose those times when the difference between the hour and minute hands is closest to 120 degrees. The closest difference is 4/11 (.3636) circle at T=9-1/11 hours and T=2-10/11 hours. So the answer is 2 hours, 54 minutes, 35 seconds. The only other time could have been 9 hours, 5 minutes, 25 seconds.

LITTON INDUSTRIES
Beverly Hills, California

ITT JOINS TWO DIVISIONS TO FORM ITT FEDERAL LABORATORIES



T

holding of 24,326; acquisition of 10,000 common shares by G. T. Scharffenberger, officer, making a holding of 10,000; disposition of 2,000 common shares and acquisition of 347 common shares (received from partnership) by Joseph A. Thomas, director, making a holding of 13,347, and disposition of 5,000 indirectly owned common shares (distributed by partnership) leaving a holding of 10,000 (indirect holding in Trusts remains 206); disposition of 2,900 common shares by Charles B. Thornton, officer and director, leaving a holding of 288,905 (indirect holding remains 30,430).

Litton Industries, Inc. Disposition of 135 common shares by Charles R. Abrams, Jr., officer, leaving a holding of 5,400; acquisition of 1,000 common shares (private transaction) by Harry J. Gray, officer, making a holding of 6,342; disposition of 3,000 common shares by Joseph A. Thomas, director, leaving a holding of 10,681 (indirect holdings in trust remain 211, and indirect holdings in Lehman Bros. remain 10,250); disposition of 4,400 common shares (4,000 shares as transfer of community property interest) by Charles B. Thornton, officer and director, leaving a holding of 291,646 (indirect holdings in partnership remain 31,191).

Martin Co. Acquisition of 1,050 capital shares through exercise of option by Albert C. Hall, officer, making a holding of 1,050.

McDonnell Aircraft Corp. Disposition of 300 common shares by Dolor P. Murray, Jr., officer, leaving a holding of 708; disposition of 100 common shares by Kendall Perkins, officer and director, leaving a holding of 592.

North American Aviation. Acquisition of 200 common shares by Alexander T. Burton, officer, making a holding of 434; disposition of 1,000 common shares by R. A. Lambeth, officer and director, leaving a holding of 200; acquisition of 500 common shares by Rulon Nagely, officer, making a holding of 500; acquisition of 500 common shares by J. B. Pearson, Jr., officer, making a holding of 1,800.

Northrop Corp. Acquisition of 1,800 common shares through exercise of option by Thomas B. Jones, officer, making a holding of 4,050; acquisition of 100 common shares through exercise of option by Irving Roth, director, making a holding of 380.

Pacific Northern Airlines. Acquisition of 500 common shares by D. B. Hart, officer, making a holding of 7,000.

Pacific Northern Airlines. Disposition of 1,500 common shares by Robert A. Rowan, director, leaving a holding of 14,500.

Pan American World Airways. Acquisition of 1,875 capital shares through exercise of option by Wilbur L. Morrison, officer, making a holding of 17,187; disposition of 100 capital shares by John S. Woodbridge, officer, leaving a holding of 600; disposition of $7,000 of $4\frac{7}{8}$% convertible subordinated debentures by Alvin P. Adams, officer, leaving a holding of $100.

Pan American World Airways. Disposition of 634 capital shares by R. G. Ferguson, officer, leaving a holding of 4,940; acquisition of 1,875 capital shares through exercise of option by Harold E. Gray, officer, making a holding of 10,927; acquisition of 3,750 capital shares by Roger Lewis, officer and director, making a holding of 5,825; acquisition of 1,500 capital shares through exercise of option by Willis G. Lipscomb, officer and director, making a holding of 13,408; acquisition of 375 capital shares through exercise of option by Wilbur L. Morrison, officer, making a holding of 17,562.

Piper Aircraft Corp. Disposition of 305 common shares by Charles W. Pool, officer and director, leaving a holding of 200.

Piper Aircraft Corp. Disposition of 130 common shares by Walter C. Jamouneau, officer and director, leaving a holding of 200.

Raytheon Co. Acquisition of 1,000 common shares by Richard D. Krafve, officer and director, making a holding of 4,050.

Rockwell Standard Corp. Disposition of 1,500 common shares by George T. Pew, director, leaving a holding of 91,066.

Ryan Aeronautical Co. Acquisition of 1,944 common shares through exercise of option by Robert L. Clark, officer, making a holding of 3,888; acquisition of 1,050 common shares through exercise of option by Owens S. Olds, officer, making a holding of 1,050.

Servomechanisms, Inc. Disposition of 4,000 common shares by William W. Shannon, officer, director and beneficial owner, leaving a holding of 76,400 (indirect holding remains 54,550); disposition of 6,000 common shares by Ernest W. Wester, director, leaving a holding of 13,000.

Thiokol Chemical Corp. Acquisition of 21,583 common shares through exercise of option by J. W. Crosby, officer and director, making a holding of 48,856.

Thompson Ramo Wooldridge, Inc. Disposition of 800 common shares by Harold L. George, director, leaving a holding of 29,335.

United Air Lines. Disposition of 100 common shares by O. T. Larson, officer, leaving a holding of 632; disposition of 400 common shares by Charles F. McErlean, officer, leaving a holding of 539; disposition of 100 common shares by Dick R. Petty, leaving a holding of 2,176.

United Air Lines. Acquisition of 2,000 common shares through exercise of option by R. F Ahrens, officer, making a holding of 3,679; disposition of 100 common shares by Curtis Barkes, officer and director, leaving a holding of 4,849; acquisition of 6,209 common shares through exercise of option by John A. Herlihy, officer and director, making a holding of 8,840; acquisition of 500 common shares through exercise of option by Charles M. Mason, officer, making a holding of 645.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command Aeronautical Systems Center:

Telecomputing Corp., North Hollywood, Calif., coder, transponder, KY-95A/APX-25, 102 ea.; control, coder group, C-1128/APX-25, 80 ea. (to be used by Federal Aviation Agency) supplemental agreement No. 4 to contract AF 33(600)41553, $32,188.

Flying Tiger Line, Inc. Burbank, Calif., CRAF group A modification of contractor-owned CL-44D aircraft, contract AF 33-(600)42031, $252,164.

Montrose Division, The Bendix Corp., South Montrose, Penna., indicators, electrical tachometer, type ERU-6/A, Aerno 60-2500 (installations on T-38A aircraft), IFB 33-600-61-53, contract AF 33(600) 42134, 576 ea., $71,245.

Kearfott Division, General Precision, Inc., Little Falls, N. J., indicators, master class II, Aerno 60-1528, manufacturer's P/N 425617-2A, 24 ea.; indicators, computer true heading type CP-308/AJA-1, Aerno 60-1529, manufacturer's P/N 512654-1A, 52 ea., letter contract AF 33(600)42232, $103,372.

Sylvania Electrical Products. Buffalo, N. Y., various components of AN/APN-81 doppler radar sets and data, letter contract AF 33(600)42328, $350,000.

The ARO Equipment Corp., Bryan, Ohio, converter, liquid oxygen, type A-2, in accordance with specification MIL-C-6650, revision E dated June 11, 1958, Aerno 46-0102 (applicable to KC-135A series aircraft (installations for Fiscal Year 1961) IFB 33-600-60-59, contract AF 33(600)42392, 87 ea., $52,349.

Phaostron Instrument and Electronic Co., South Pasadena, Calif., indicator, ID-351B/ARN, in accordance with specification MIL-I-8303A dated July 21, 1958, Aerno 81-3371 (Usage: Navy installations and spares) supplemental agreement No. 5 to contract AF 33 (600)39915, 435 ea., $133,545.

Cook Technological Center Division, Cook Electric Co., Morton Grove, Ill., runway circling guidance light, obstruction marker light, contract AF 33(600)41993, $37,871.

Heiland Division, Minneapolis Honeywell Regulator Division, Denver, Colo., electronic flash units, contractor's model Strobonar 91B, FSN 6760-664-3323-J360 and accessories and instruction handbooks, contract AF 33(600)42076, 149 ea., $35,094.

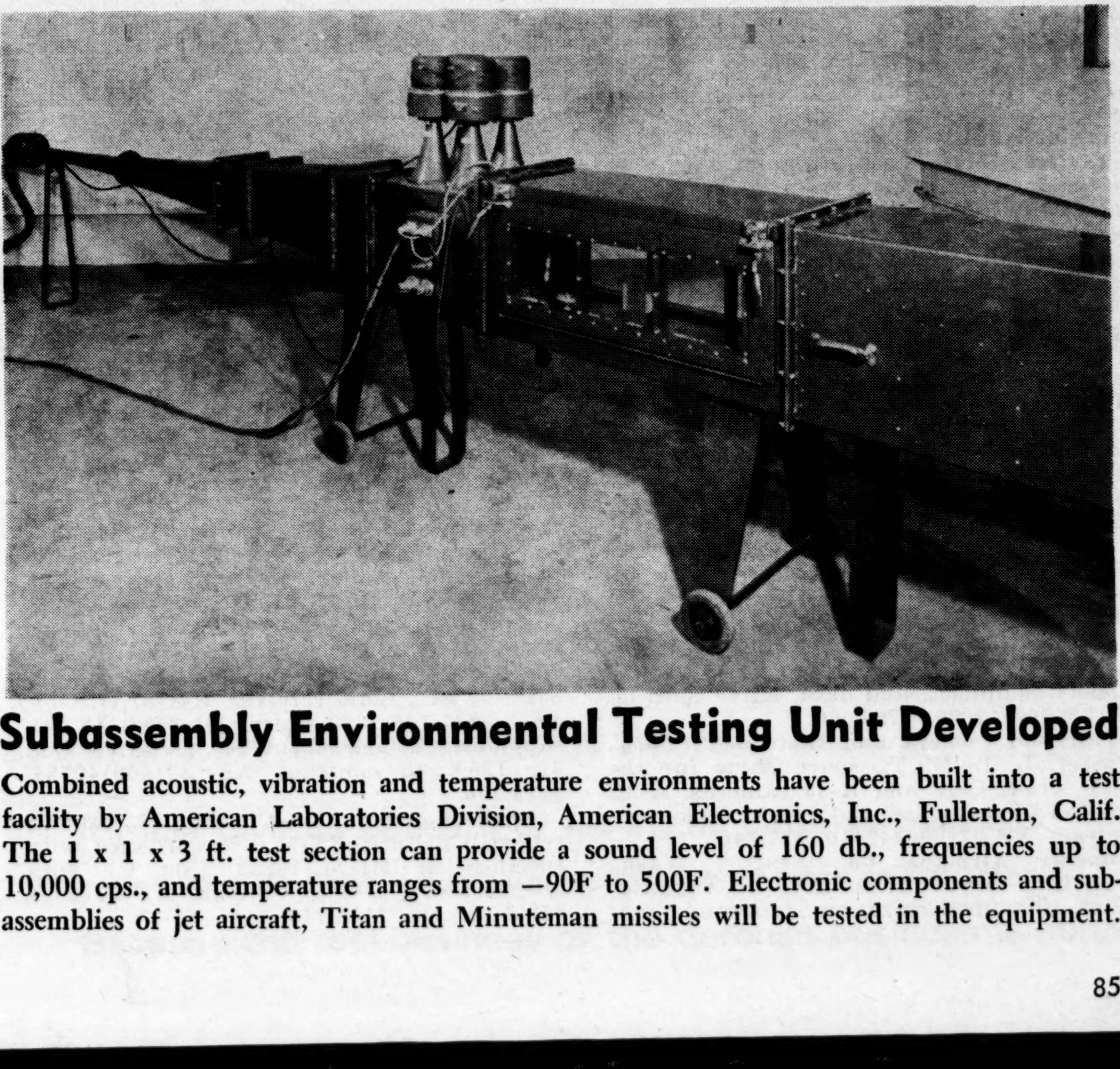
Lear, Inc., Grand Rapids, Mich., product improvement of remote attitude indicators, contract AF 33(600)42113, $110,811.

Courter Products Division, Model Engineering and Manufacturing, Inc., Boyne City, Mich., indicators, pressure hydraulic, type AGU-3/A, in accordance with specification MIL-I-27190(USAF) dated June 10, 1959, Aerno 61-2501 (installations for T1-38A aircraft), and data, IFB 33-600-61-55, contract AF 33(600)42353, 606 ea., $44,255.

Beech Aircraft Corp., Wichita, Kan., contractor's commercial type handbooks for the L-23 aircraft and related data, supplemental agreement No. 9 to contract AF 33(600)39671, 40 sets, $62,831.

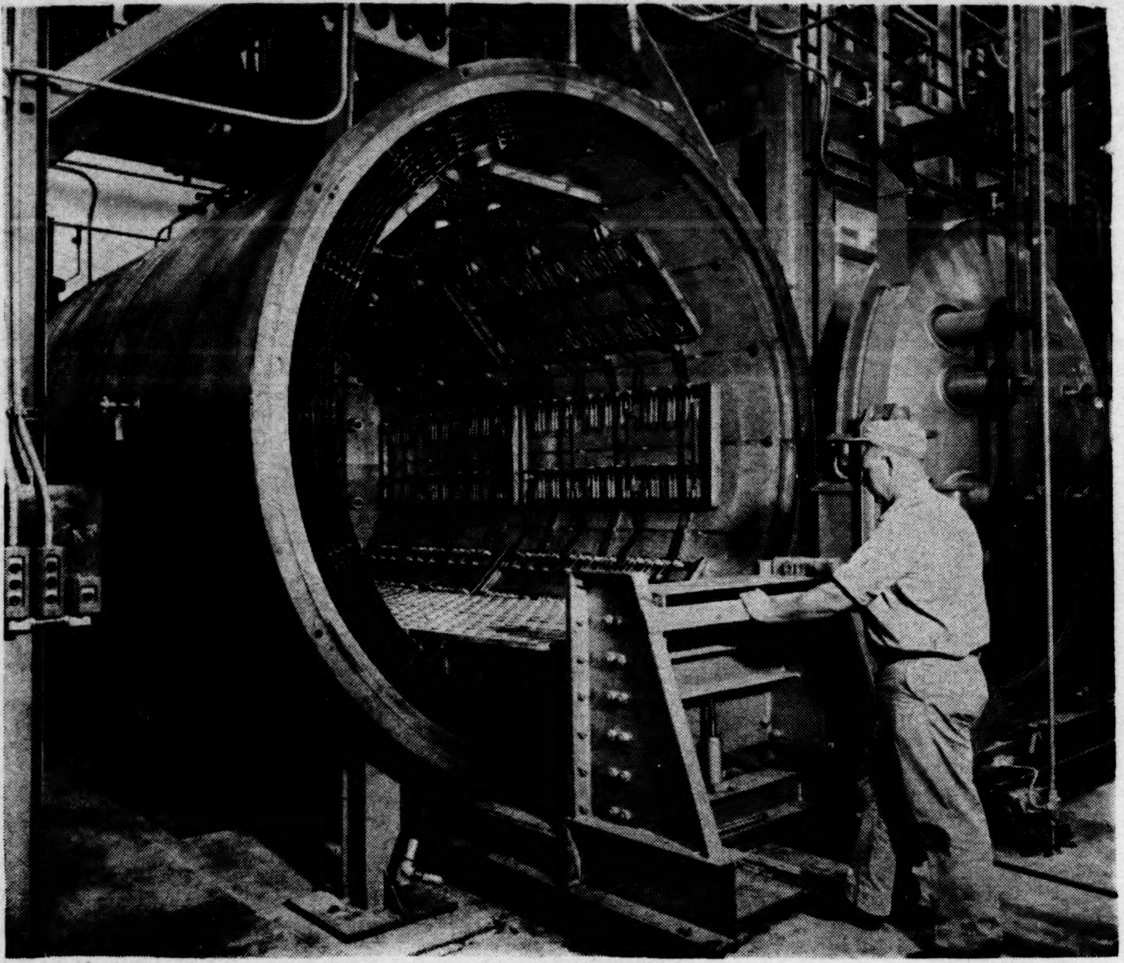
Astronautics Corporation of America, Milwaukee, Wis., indicators, rate of flow, fuel, type AFU-2/A, Aerno 61-2490, contractor's P/N 126000-0001, spare parts, ground support equipment and data, IFB 33-600-61-17, contract AF 33(600)42223, 104 ea., $43,602.

General Electric Co., West Lynn., Mass., transmitter, rate of flow, type TRU-6/A,



Subassembly Environmental Testing Unit Developed

Combined acoustic, vibration and temperature environments have been built into a test facility by American Laboratories Division, American Electronics, Inc., Fullerton, Calif. The 1 x 1 x 3 ft. test section can provide a sound level of 160 db., frequencies up to 10,000 cps., and temperature ranges from —90F to 500F. Electronic components and subassemblies of jet aircraft, Titan and Minuteman missiles will be tested in the equipment.



Furnace Treats Steel Alloys for Atlas Missile

Steel alloys for the Convair Atlas intercontinental ballistic missile are heat-treated in a vacuum-type furnace at 2,150F. The coldwall furnace, measuring 10 ft. long by 6 ft. in diameter inside, is used to anneal, homogenize and temper stainless steel alloys. Power for the electrofurnace is supplied by a 1,000-kw. substation generator. The manufacturer of the furnace is F. J. Stokes Corp., Philadelphia, Pa.

contractor's P/N 8TJ61GAB-1, FSN 6620-618-5979, Aerno 61-2491, spare parts, ground support equipment and data, IFB 33-600-61-17, contract AF 33(600)42224, 5,313 ea., $458,709.

General Electric Co., Milwaukee, Wis., spare parts for C-11 magazine M-2 camera control and C-7 camera body (components of KS-32 radar recording camera system), contract AF 33(600)42314, $150,595.

Instrument Division, Thomas A. Edison Industries of McGraw-Edison Co., West Orange, N. J., indicators, pressure, oil, type MS-24576-1, contractor's P/N 296-100P1, Aerno 61-2503 (installations for F-105D aircraft, fiscal year 1961), spare parts, ground support test equipment and data, contract AF 33(600)24348, $29,907.

Electrosolids Corp., Panorama City, Calif., inverters, power, static, in accordance with Republic specification control drawing 79F908102, revision F, dated Apr. 6, 1960, contractor's P/N W-1377-1, Aerno 42-2321 (installations for F-105D, and related data, contract AF 33(600)42370, 220 ea., $506,150.

Penn Keystone Corp., Derby, Conn., inverter, position, variable nozzle, type MS-24572-2, in accordance with specification MIL-I-27191 dated June 1, 1959, amendment No. 1 dated July 14, 1960 and drawing MS 24572-4, Aerno 60-3177 (T-38A aircraft spares) and data, IFB 33-600-61-65, contract AF 33(600)42530, 722 ea., $42,392.

Schweizer Aircraft Corp., Elmira, N. Y., TS-1A-SW and S-2A-SW gliders with related trailers and winches, letter contract AF 33(600)42000, $180,000.

Collins Radio Co., Cedar Rapids, Iowa., radio set, AN/ARC-58, spare parts ground support equipment and data, letter contract AF 33(600)42096, $796,000.

Fairchild Camera and Instrument Corp., Syosset, L. I., N. Y., spare parts for the K-17 series, O-15 and K-38 cameras, A-9B and C-1A magazines and LA-51 lens cone, contract AF 33(600)42416, $27,140.

Boeing Airplane Co., Seattle, Wash., acquisition and installation of facilities under the modernization program, supplemental agreement No. 13 to contract AF 33(600)36041, $142,000.

Aerosonic Corp., Clearwater, Fla., altimeter, pressure, AAU-2/A in accordance with specification MIL-A-27391 (USAF) dated Apr. 25, 1960, with exceptions thereto (installations for F-105D aircraft) spare parts, ground support equipment and data, IFB 33-600-61-210, contract AF 33(600) 42448, 220 ea., $108,000.

Astronautics Corporation of America, Milwaukee, Wis., indicator, temperature, synchro, type EHU-1/A (0°C to 1,200°C), in accordance with specification MIL-I-25685 dated Jan. 22, 1957 and amendment No. 1 dated Mar. 8, 1960, Aerno 61-8860, spare parts and ground support equipment, IFB 33-600-61-71, contract AF 33(600) 42410, 160 ea., $37,600.

General Electric Co., West Lynn, Mass., amplifier, synchro signal, temperature, type ASU-1/A 0°C to 1,200°C) contractor's P/N 8KE55AAB-1, FSN 5990-622-2167, Aerno 61-8859, spare parts and ground support equipment (installations and spares for SC-130B and C-130B aircraft), IFB 33-600-61-71, contract AF 33(600)42450, 160 ea., $145,600.

The Goodyear Tire and Rubber Co., Akron, Ohio, wheel assemblies, main, type VII, 26x6.6, contractor's P/N 9541625, Aerno 41-7380, 104 ea.; brake assemblies for 26x6.6 main wheel, type VII, contractor's P/N 9541626, Aerno 41-7381, 104 ea. (installations for T-39A aircraft) supplemental agreement No. 4 to contract AF 33(600)41306, $37,752.

Sparton Electronics Division, Sparton Corp., Jackson, Mich., radio receiver, R-844/ARN-58, FSN 5826-706-2060, Aerno 81-8088, 39 ea.; radio receiver, R-843/ARN-58, FSN 5826-706-1389, Aerno 81-8093, 43 ea., supplemental agreement No. 3 dated Oct. 31, 1960, to contract AF 33(600)40754, $123,966.

Burke & James, Inc., Chicago, Ill., camera set, still picture, KS-7, in accordance with specification MIL-C-13959 (Sig C) with amendment No. 3 to contract AF 33(600) 41805, 92 ea., $146,740.

FAA Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by the Federal Aviation Agency:

Peer, Inc., Benton Harbor, Mich., contract FA-1744(1-1059B1), ILS monitor and control equipment, 20 ea., spare parts set for use with item 1, five sets; control unit, ILS glide slope and localizer transmitter stations, 41 ea., spare parts set for use with item 3, five sets; ILS automatic transfer unit, 42 ea., spare parts set for use with item 5, five sets; localizer glide slope control rack, set, 22 sets, preparing and furnishing replaceable parts list for items 1, 3, 5 and 7, four sets, identification for replaceable parts in items 1, 3, 5 and 7, 100 ea., $196,527.

Nems-Clarke Co. Division, Vitro Corporation of America, Silver Spring, Md., contract FA-1785(1-1047B1), transmitter, marker beacon, ILS, 40 ea., spare parts sets for use with item 1, five sets; antenna and feeder assembly, marker beacon, 40 ea., spare parts sets for use with item 3, five sets; transmitter, compass locator, 40 ea., spare parts sets for use with item 5, five sets; prepare and furnish replaceable parts lists for items 1, 3 and 5, three lists, item identification for replaceable parts in items 1, 3, and 5, 100 ea., $153,734.

Freedman and Freedman Co., Inc., Brooklyn, N. Y., contract FA-1797(1-1101B1), send terminal, in accordance with contract, 433 ea., spare parts set for use with item 1, 44 sets; receive terminal, in accordance with contract, 163 ea., spare parts set for use with item 3, 16 sets, preparing and furnishing replaceable parts list for items 1 and 3, one list ea., item identification for replaceable parts in items 1 and 3, estimated 15 ea., $31,379.

Lenkhurt Electric Co., Inc., San Carlos, Calif., contract FA-1782(1-1176B1), terminal carrier telephone. Lenkhurt Electric Co., Inc. model 33B1-E7615, in accordance with contract, four ea., spare parts set for use with item 1, four sets; accessory kit in accordance with contract, four kits, $36,711.

Gertsch Products, Inc., Los Angeles, Calif., contract FA-1784 (I-1179B-1), meter, frequency, VHF, Gertsch Products, Inc., model FM-3/PS-3, including attenuator, Gertsch Products, Inc., model RFApl, in accordance with contract, 30 ea., $26,386.

Amco Engineering Co., Chicago, Ill., contract FA-1906(1-1182B1), console, two-position, in accordance with contract, 54 ea., $29,049.

Farinon Electric Co., Redwood City, Calif., contract FA-1793 (1-1189B1), radio link, VHF/FM, in accordance with contract, 8 ea., spare tubes, fuses and lamps, set for use with item 1, eight sets, instruction book for use with item 1, in accordance with contract, one set, $33,369.

Summit Industries, Inc., Gardena, Calif., contract FA-1907 (1-3143B1), shelter, ILS localizer antenna, 2′6″ diameter dome shaped, reinforced plastic, in accordance with specification FAA-1105b and FAA drawing D-5124, 610 ea., $42,248.

Wheeling Corrugating Co., Wheeling, W. Va., contract FA-1775 (1-3116B1), mesh, expanded metal, ¾″ opening, 9 gauge, type i, grade A, class 2, commercial style designation, 6′x10′ sheets, galvanized, in accordance with specification MIL-M-17194C, 130,000 sq. ft., $40,924.

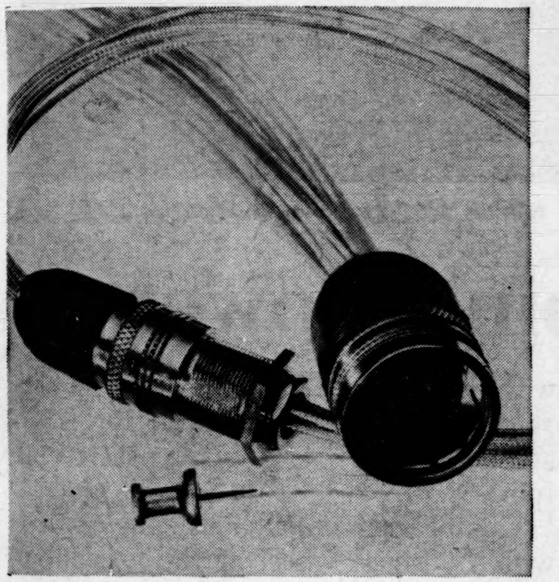
Hewlett-Packard Co., Palo Alto, Calif., contract FA-1778 (1-1144B1), signal generator, VHF, Hewlett-Packard Co. model 614A, 22 ea., preparing and furnishing replaceable parts for item 1, one list, item identifications for replaceable parts in item 1, estimated 100 ea., $47.832.

Hult Construction Corp., Silver Spring, Md., contract FA-1926(1-3224B1), furnishing labor, all equipment, and materials and perform all work for construction of grade separation structures for the east-west service road over the access road over the access highway and ramp R over the toll plaza, in connection with the development of the Dulles International Airport, estimated sum, $197,890.

Microdot Appoints Avnet for Multi-Pin

LOS ANGELES—An exclusive long term agreement for the distribution of Microdot's new microminiature Multi-Pin connector series has been awarded by Microdot to Avnet Electronics Corporation.

Microdot's Multi-Pin is only one-quarter the size of present "miniature" types and features complete interchangeability of parts. Multi-Pin inserts are available in a variety of straight power, straight coaxial, and combination power-coaxial layouts. Power contacts are interchangeable without changing inserts, allowing hermaphroditic contact arrangements to be set up (a mixture of male and female contacts within the plug or receptacle, allowing hot leads to both plug and receptacle).



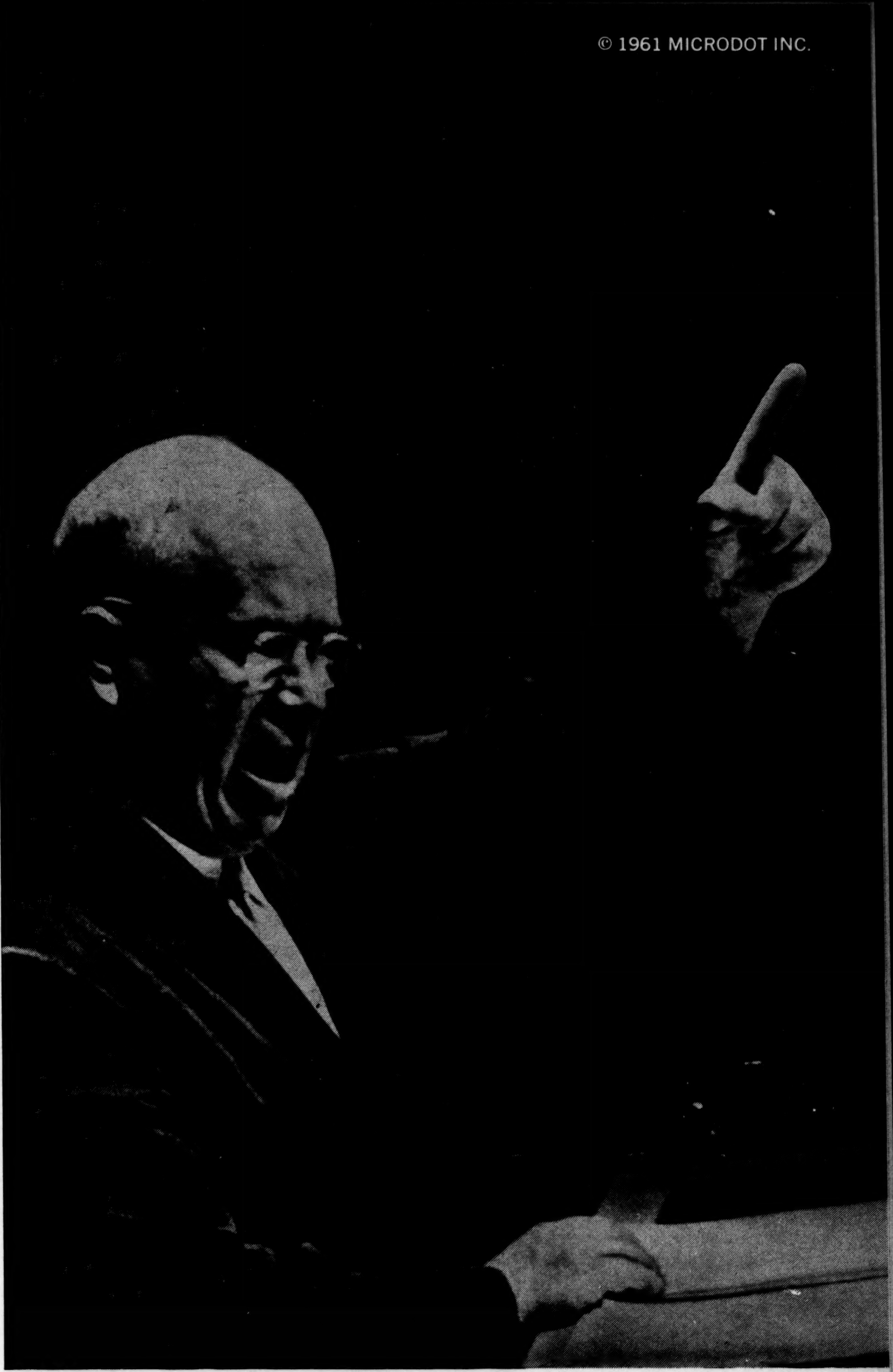
Available in three shell sizes, Microdot's Multi-Pins can contain up to 61 power or 19 coaxial contacts in a 1¼" shell.

According to Microdot, Avnet will supplement Microdot's sales engineers and seventeen sales representatives with their own sales engineering staff and provide an extremely well organized and broad based national distribution from Avnet's eight stocking locations. The agreement applies to the standard line of cylindrical Multi-Pin connectors, with a separate non-exclusive agreement covering other types and Microdot's coaxial connectors and cable. Present distributors for Microdot will continue to carry the standard line of coaxial connectors and cable on a non-exclusive basis.

Avnet currently has a large initial Multi-Pin stocking order in each of their facilities for immediate delivery. Future orders are expected to be substantial.

MICRODOT INC.

220 Pasadena Avenue
South Pasadena, California



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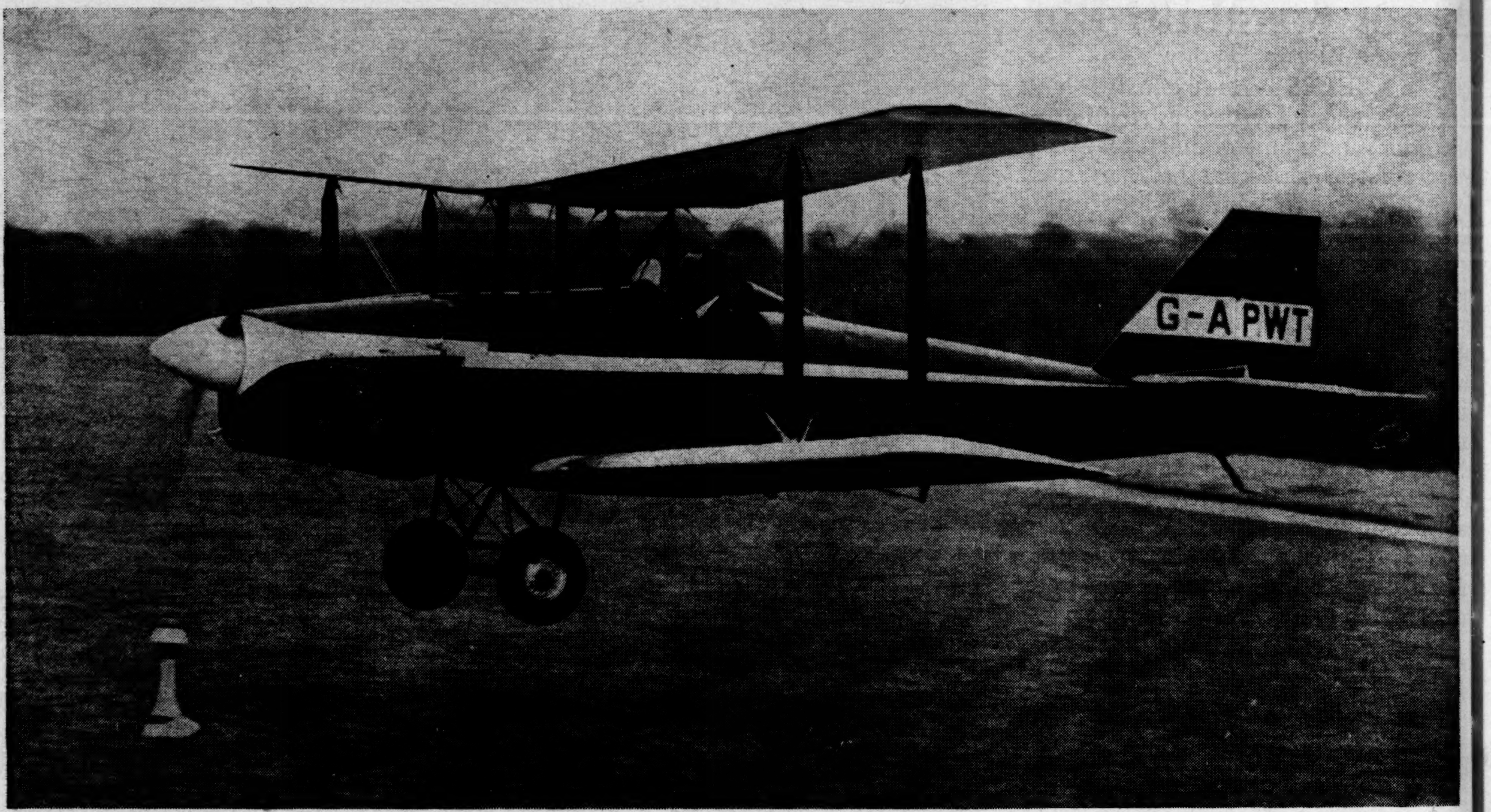
TALK IS NOT CHEAP

To negotiate the Cold War requires two costly elements:
A position of undeniable strength; and time.

That's where defense comes in. To provide the strength.
To buy the time for reason to prevail.

It must give us pause. For we in the defense business
must realize that what we do keeps fingers off buttons.
Because the real business of the defense business is survival.



ROVER 60-bhp. turbine in British Currie Wot burns either kerosene or diesel fuel; main air intakes are located on side cowling.

Currie Wot Flies With Turbine Power

London—British Currie Wot biplane has been successfully test flown using a T.P.60-bhp. turbine engine developed by Rover Co., Ltd., of Solihull, a longtime builder of automobiles and aircraft auxiliary power units.

Powerplant used in the flight is one of two developed by Rover; other is a 90-bhp. model which has a maximum takeoff rating of 120 bhp. and is virtually the same engine except that it runs at a higher temperature with a modified impeller. Both powerplants weigh 235 lb.

The smaller model utilizes a fully automatic variable pitch propeller, also designed by Rover; larger engine propeller controls are hydraulic. The T.P. 90 engine has run for more than 1,000 hr. on bench tests. Company spokesman said the engine, in aircraft utilization, should have an initial rating of about 300 hr. between overhauls.

Sales Price

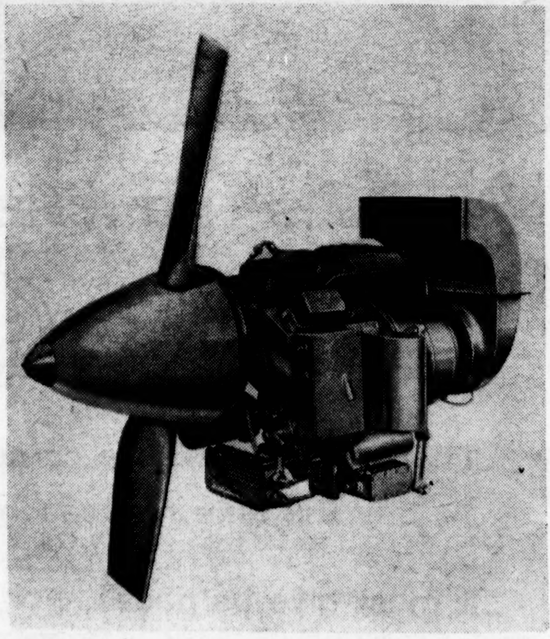
Rover officials said estimated sales price of the engines, complete with variable pitch propeller, will be about $4,200, depending on demand. Industrial equivalent of the turbine sells for $2,940 for the 60-bhp. version and $3,790 for the 90-bhp.

Rover entered the turbine engine field in 1940 through an association with Air Commodore Sir Frank Whittle in development of the Whittle jet engine for aircraft. Later, Rover worked with Rolls-Royce in design of the Nene and Derwent turbine. In the automotive field since 1904, Rover first tested a turbine powered auto on Mar. 9, 1959.

In the aircraft field, Rover builds auxiliary power units for the Vulcan bomber and the Armstrong Whitworth 660 military transport.

Maximum power fuel consumption of the engines are 1.36 lb./bhp./hr. and 1.48 lb./bhp./hr., respectively.

T.P. 60 is a single-spool engine with a single-stage, centrifugal compressor, one reverse-flow combustion chamber with down-stream injection and a single-stage turbine. Pressure ratio is 2.95:1 and air mass flow 1.45 lb./sec. at 46,000 rpm.



ARTIST'S conception shows 90-bhp. model in pusher configuration.

Compressor impeller is single-sided with 17 vanes, wheel of the axial flow turbine is of Nimonic 90 and turbine inlet temperature is 800C at 46,000 rpm.

Shaft Speed

Power outlet is by reduction gear, giving an output shaft speed of 2,325 rpm.

Control system is mechanical with automatic overpower and high temperature controls and variable engine speed.

A Rover multi-piston pump supplies fuel at 250 psi. full-load pressure and 600 psi. maximum pressure. It has centrifugal governing with internal adjustment to prevent overspeeding. Rover has designed for the engine a novel automatic variable pitch propeller, mechanically compensated for engine speed and power.

The engine's specific weight is 3.36 lb./hp. and specific fuel consumption is 1.36 lb./bhp./hr. maximum takeoff (70 bhp. at 47,000 rpm.) and 1.48 lb./bhp./hr. at maximum cruise (60 bhp. at 46,000 rpm.).

Engine is 20-in. wide, 27.5-in. high and 30.1-in. long, plus a further 18.9 in. for propeller and spinner.

T.P. 90 is of identical size and weight, but has an increased rating of 120 bhp. at 47,000 rpm. maximum takeoff and 90 bhp. at 46,000 rpm. maximum cruise. Design is similar, but pressure ratio is decreased to 2.8:1 and air mass flow increased to 1.88 lb./sec. at 46,000 rpm.

Turbine wheel is of Nimonic 105 and inlet temperature is 809C.

Specific weight of the larger engine is 1.96 lb./hp. and fuel consumption is 1.38 lb./bhp./hr. at maximum power.

Engines for the Currie Wot were developed by Rover Gas Turbines, Ltd., a subsidiary of the auto company. Cruising rpm. of the 60-bhp. model propeller is 2,325 rpm. and starting is automatic. Plane's battery is 12 v. and instrumentation is an rpm. gage and tailpipe temperature indicator.

Rover said its flight test program for the smaller engine has been completed and the powerplant now is available for commercial sales. Larger engine has not yet been flight tested.

High drag ratio of the Currie Wot limits speeds to those obtainable with its 65-hp. Walter Mikron piston engine —85 mph.—but takeoff and climb performance are said to be greatly improved with turbine power.

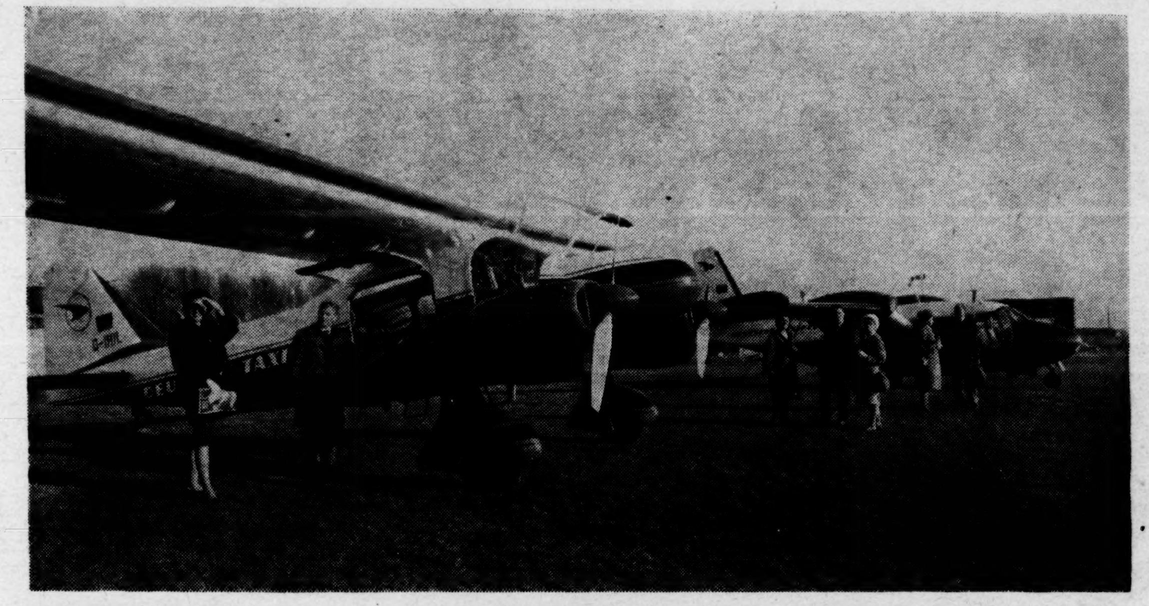
The airplane was designed in 1937 by J. R. Currie; two prototypes were destroyed during World War II bombing raid.

In 1958, the Hampshire Aeroplane Club, Southampton, built the plane used in the turbine test flights.

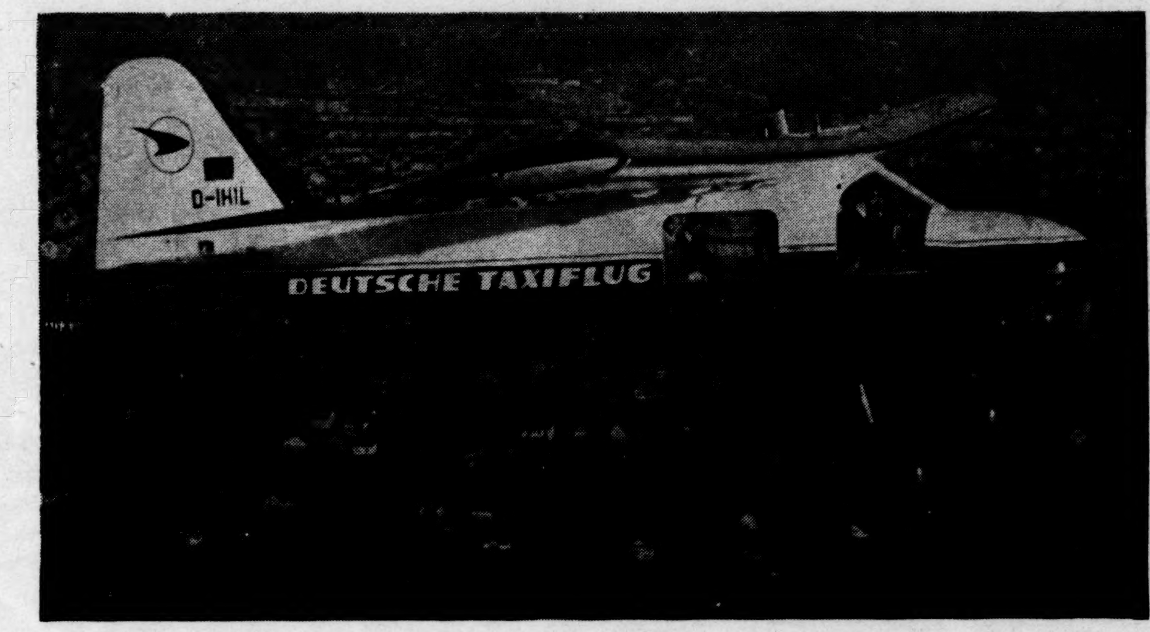
The Wot is a single-seater, designed for aerobatics, and this regime can be continued with the Rover turbine, which has an inverted flight time of 15 sec. Plane is all-wood construction and wing-span is 22 ft. 1 in.; length is 18 ft. 9 in. and gross weight is 700 lb.

Lockheed Sells 39 JetStar Transports

Approximately 39 Lockheed JetStar four-jet executive transports have been sold and the first delivery is now scheduled for April or May, with airplane going into shops for interior and electronics equipment outfitting just prior to the final certification, and becoming operational in June or July after certification is granted by FAA. Service personnel of initial customers, including Pratt & Whitney Aircraft, Superior Oil and Continental Oil Co., already have entered ground school course at Marietta, Ga. Pilot courses start in late March or early April. Indications are that Lockheed has satisfactorily solved the compressor stall problems that occurred when the airplane was in high angle-of-attack position by installing a system of cross-vanes in the engine inlets for desired air flow.



DORNIER DO-28 twin and a Piaggio P.166 are on the line at Deutsche Taxiflug's Mannheim, Germany, facility. Firm now is operating first two of four Do-28s on order.



West German Charter Line Buys Do-28 Twins; Plans Expansion

By Edith Walford

Mannheim—Deutsche Taxiflug GmbH., a relatively new, rapidly expanding West German charter company, is drafting plans to accelerate and expand its schedule in 1961.

Founded in April, 1959, Deutsche Taxiflug began operations shortly afterwards with four single-engine Dornier Do-27s shuttling passengers between the Hanover Air Show at Hanover-Langenhagen airport and the traditional Hanover Industrial Fair held on grounds at the opposite end of town. Charge for the 7-min. roundtrip between the two sites was $7.50 per person.

By the close of 1960, the carrier had 10 Do-27s, a Scottish Aviation Twin Pioneer and a Piaggio P.166 in service and had received the first of four twin-engine Do-28s on order. Remaining two Do-28s plus a Piper PA-18 are scheduled to be delivered in the near future.

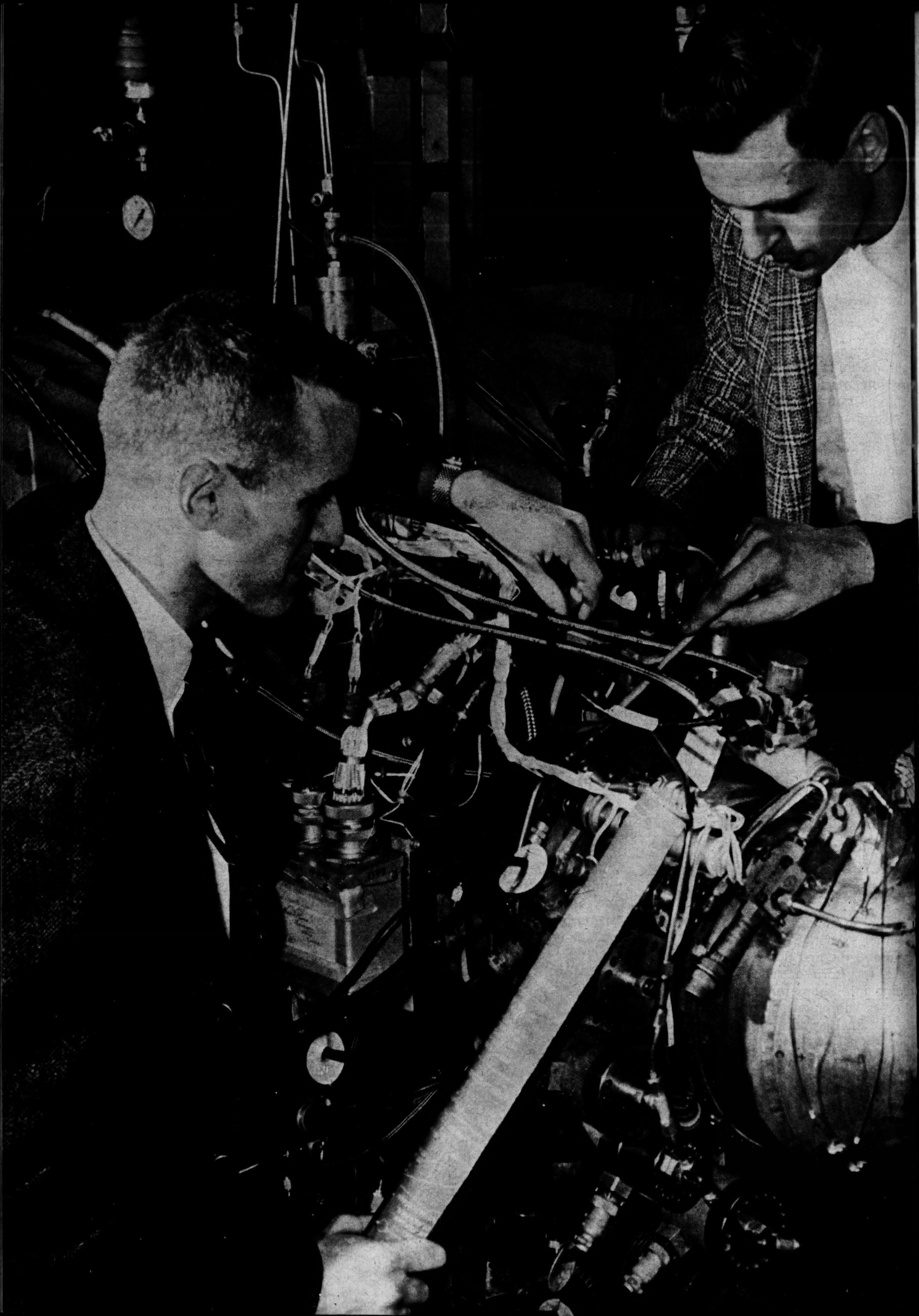
During its first six months of operation—from Apr. 1 to Sept. 30, 1959, Taxiflug carried a total of 11,008 passengers on 4,147 flights covering 155,520 mi.

Comparable figures for 1960, over a slightly longer time period—Apr. 1 to Nov. 20—show that the line carried 24,105 passengers plus 61 U. S. tons of freight on 9,908 flights over a distance of 403,650 mi.

Four Do-28s will serve the firm's longer domestic routes and help fill the growing demands for year-round charter service to a number of other European countries, particularly Italy, France, Switzerland and England.

To be available on short notice, the Do-28s will be stationed at four of Germany's major airports—Frankfurt/Main, Mannheim, Hamburg and Munich. The two aircraft already on hand are operating from Frankfurt/Main and Mannheim.

Taxiflug also plans to introduce direct roundtrip Do-28 service between Hamburg and the island of Heligoland in the North Sea, a route it checked out



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last year on proving flights with the Twin Pioneer. Present plans call for two daily Do-28 roundtrips, supplemented when demand warrants by Twin Pioneer flights.

Deutsche Taxiflug estimates the flight hour cost of the various aircraft now in use as:

- **Five-seat** Dornier Do-27—$63.
- **Five-seat** Dornier Do-28—$93.
- **Eight-seat** Piaggio P.166—$135.
- **Two-seat** Piper PA-18—$20.

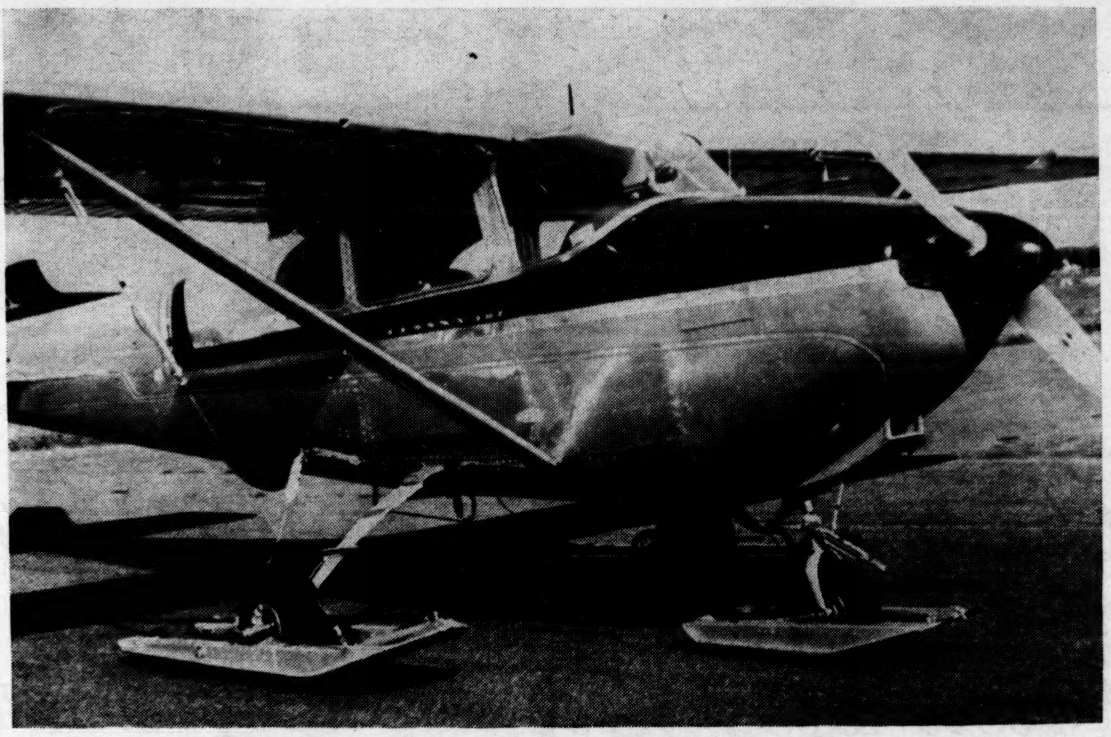
The company's provisional 1961 flight operations include:

- **Air taxi services** from Mannheim, Munich, Frankfurt/Main, Hamburg and Dusseldorf.
- **Shuttle services** between Hanover Industrial Fair and the Sixth International Shoe, Leather and Machinery Fair at Pirmasens/Saar.
- **Seaside resort services** from Dusseldorf, Hanover, Bremen and Hamburg to East and North Friesland and Heligoland.
- **Feeder Services** between Karlsruhe-Mannheim-Frankfurt/Main, Saarbrucken-Pirmasens-Frankfurt/Main and Garmisch-Munich.

Examples of typical charges per person for the round-trip flights include:

- **Frankfurt-Pirmasens**—$22.
- **Frankfurt-Saarbrucken**—$27.50.
- **Frankfurt-Mannheim**—$15.
- **Saarbrucken-Mannheim**—$19.

Taxiflug says that interest among German businessmen and tourists in these services is increasing steadily. With the additional four Do-28s all in service soon, Deutsche Taxiflug expects to again boost its year-end results considerably.



Ski Developed for Tricycle Gears

New ski concept for tricycle gear lightplanes is being put into production by FluiDyne Corp., Minneapolis, Minn.; units are mounted here on a Cessna 182. Skis utilize a load transfer plate, controlled hydraulically from the cockpit, to move them from the "gear" position, in which wheel extends through the ski for conventional landing, to "ski" position, where wheel rests on the ski base.

Mooney Sells Stock For Working Capital

Requirement for additional working capital to build an inventory of materials needed to increase production schedules beyond initial targets has led Mooney Aircraft, Inc., Kerrville, Tex., to offer some 40,000 additional shares of stock, which will bring its stock outstanding to a total of some 150,000 shares.

Mooney President Hal Rachal started offering "treasury stock" in January and hopes that the total offering will bring in approximately $400,000 of working cash which will be utilized to step up production of the new all-metal Mark 21 four-place business plane (AW Feb. 20, p. 103) from a one-daily schedule beginning Mar. 1 to double this rate at the end of June. The company currently is back-ordered through July on the Mark 21.

Increased materials inventories would permit production of some 43 airplanes monthly beginning in July, bringing the firm a gross business of some $600,000 monthly and a net of some $50,000 monthly, Rachal noted.

Rachal emphasized that he is seeking investors who are not interested in speculative profits, but who may have talents which they may also wish to contribute in furthering company development in the financial and technical fields. Rachal, who has an independent income, said he has not taken any salary out of the company in seven years.

He is retaining his current holding of some 71,000 shares. This, with Executive Vice President Norman Hoffman's holding of some 40,000 shares and approximately 10,000 shares held by Mooney Sales Co., an affiliate, would be retained to maintain control over the company. Rachal told AVIATION WEEK that the firm is currently capitalized at 200,000 shares, but that the current offering would be controlled to retain some 40,000 shares for use sometime in the future if further capital was required to support new development of the company's aircraft line.

Indications are that some 10,000 shares are still remaining, with price in the neighborhood of $15. Bulk of shares released thus far have been subscribed for by Mooney distributors.

PRIVATE LINES

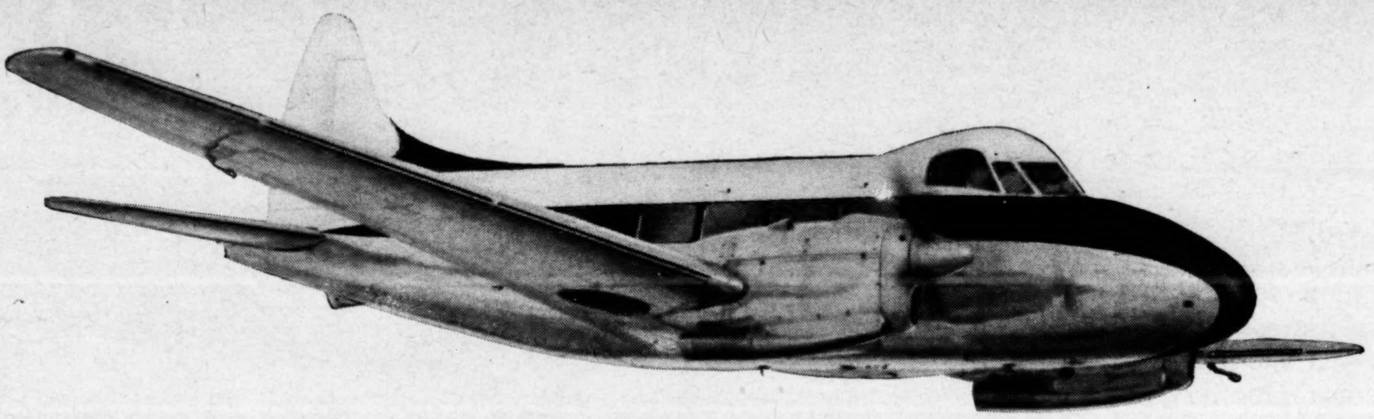
United Airplane Sales, Inc., flight school, Wichita, Kan., has become the third school to be authorized by Federal Aviation Agency to graduate students as certificated private pilots, a system developed by FAA to relieve work load on its agents who are now assigned to upgrade flight standards in other flying schools. Under previous system, FAA-designated pilots were required to give students final check rides on completion of the school's flight course. United has graduated more than 500 students and currently has 100 currently working toward certificates.

Prototype Cessna Model 320, a five-place higher performance development of the 310F powered by 260-hp. supercharged Continentals (AW Nov. 14, 1960, p. 32), is expected to start ground test program in the latter part of February. Airplane, which will be introduced into the company's 1962 line, is disguised like a 310 to prevent "leak" of configuration and performance details. Cessna already has frozen its 1962 line, to be introduced this fall.

Salton Aero Club, Palm Springs, Calif., has been chartered by the National Aeronautic Assn. Herbert Stoltmann is temporary chairman.

Air Carrier Service Corp., Washington, D. C., will represent Lake Aircraft Corp., builders of the Lake LA-4 Amphibian, in 17 foreign countries and three U. S. markets, according to John F. Strayer, Lake president. Markets here are New Jersey, metropolitan New York City, northern California and Nevada and Oregon.

Aero Commander, Inc., has cut the price of its Commander 500A twin from $75,000 to $67,500, making it more competitive with Cessna 310 and widening price gap with the Commander 500B ($81,500).



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Australian Accident Investigation Report, Part II:

Board Fails to Find F-27 Crash Cause

Following is the second part of a report to the Australian Minister of Civil Aviation, concluding an inquiry into circumstances involving a crash of a Trans-Australia Airlines Fokker F-27 Friendship turboprop transport.)

The consideration of the evidence relating to the flight of the aircraft and that relating to the examination of the wreckage thus reveals no explanation of the cause of the accident. In searching for the cause, in the circumstances which have been revealed, one leans to the conclusion that something happened within the last two or three minutes as a result of which the pilot was unaware of his actual rate of descent or that he was descending to an abnormally low altitude.

Two possibilities suggest themselves:

- **That the instruments** did not accurately record the altitude of the aircraft and the pilot was thereby misled into the belief that the altitude in the final stages was some 1,000 ft. higher than was the fact.
- **That he misread his instruments,** in particular his altimeter, or was relying on his visual observation of his surroundings without paying attention or sufficient attention to his instruments and was misled by his visual observation of the area of land and sea beneath him into the belief that the aircraft was higher than in fact it was.

The only possible plausible explanation of erroneous behavior of the instruments of such a character as to cause or contribute to the accident is revealed in evidence in relation to the possible presence of water in the static lines of the pitot static systems of the aircraft.

On this aspect of the matter considerable technical evidence has been heard by the Board and I therefore proceed to consider this possibility at some length.

The pitot static system of an aircraft is designed to transmit air pressures which exist outside the aircraft to certain of the flight instruments.

The barometric pressure outside the aircraft is transmitted through the static lines and the dynamic pressure through the pressure (pitot) lines of the system.

These pressures must be tapped from points outside the aircraft which are so located that the pressures there will not be affected by the presence of the aircraft itself. There are two independent sets of flight instruments in the aircraft. The pressures are transmitted to each set of instruments by means of two pipe lines and there is one set of two pipe lines on each side of the aircraft serving each set. The static pipe lines with which this section of the report is particularly concerned, are connected with the altimeters which register altitudes, the vertical speed indicators which register the rate of ascent and descent, and the airspeed indicators which are also connected with the pressure lines and register air speeds.

The static lines in the Fokker F-27 aircraft proceed from the wingtips along the inside of the wing to the fuselage. Upon reaching the fuselage they proceed forward for a distance in the fuselage and then descend to a position underneath the floor of the cockpit and from there pass forward under the floor and up to the instrument panel.

The descent from the top of the fuselage to the floor of the cockpit occurs at a position in the aircraft at Station 3100.

Provision for drainage is made in the wing by the presence of a nacelle drain, and provision for drainage is also made near the point where the pipe proceeds forward from Station 3100 under the floor of the cockpit.

The examination of the wreckage of the aircraft disclosed the following deficiencies in the routing of the pitot static plumbing:

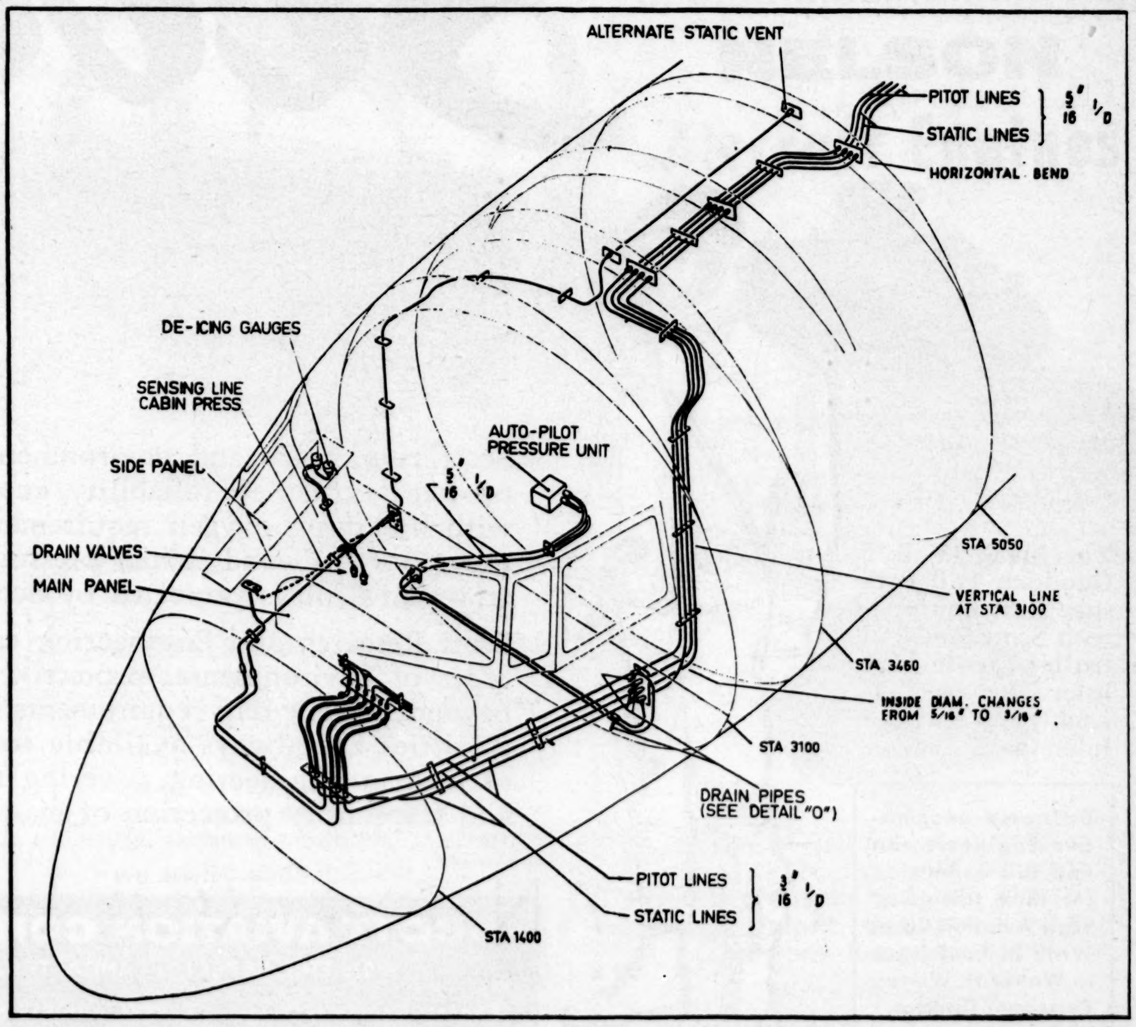
- **There was a dip** of some 2 in. in an unsupported section of the pitot and static lines in the port wing between Station 520 and the front spar bulkhead fittings near Station 0.
- **There was an upward bend** of about ½ in. in an unsupported section of the pitot and static lines in the starboard wing between Station 1040 and the front spar bulkhead fittings near Station 0. Between Stations 1040 and 520 there was a dip of 1½ in. in the static line and a dip of ¾ in. in an unsupported section of the pitot line.
- **The port system static line** in the fuselage section had not been routed through a clamp at Station 5445. This deficiency is not considered to have had any adverse effect on the operation of the port pitot static system.

The expert opinion was that these deficiencies were not consistent with the damage to adjacent structures or fittings and that they were probably present in the aircraft prior to the accident.

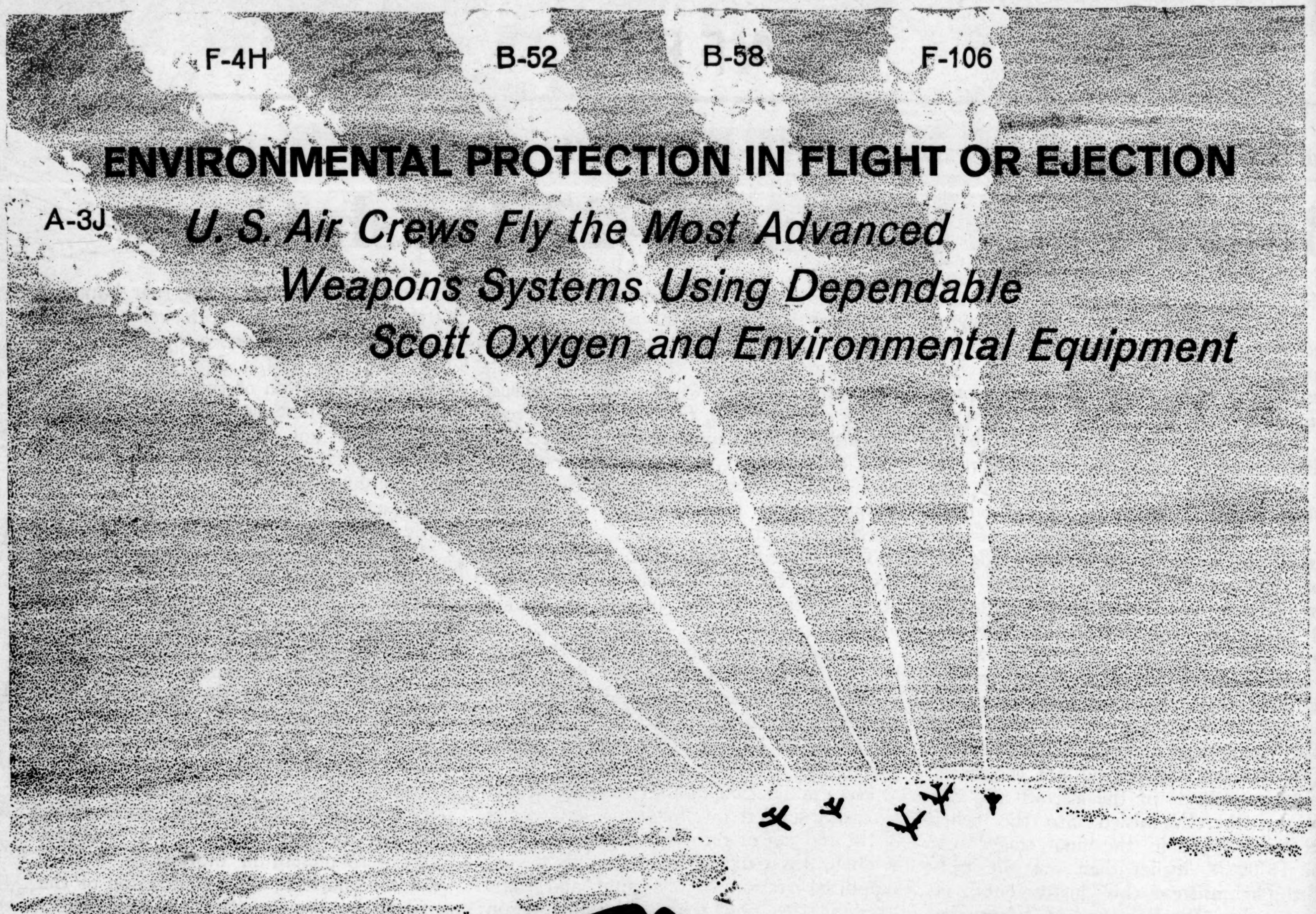
Mr. Johannes Cornelis, aeronautical engineer in charge of the production and planning department of the Fokker Aircraft Factory, did not disagree with this view.

The significance of these bends in the pitot static lines is that they could provide reservoirs for small quantities of water if water were present in the system.

In the course of the investigation of the accident by the investigation team attention was given to the possibility of the pilot having been misled by false recording of his height by his altimeter. During the course of these investigations it was learned that a Fokker F-27 operated by the



WATER in static lines of pitot static systems of the Fokker F-27 was considered a possible explanation of erroneous instrument readings which may have contributed to crash.



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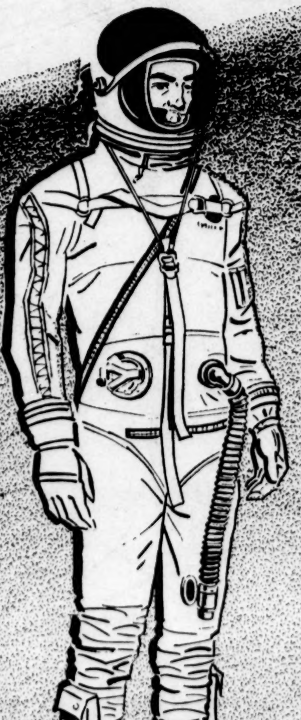

The Mark IV B. F. Goodrich Full Pressure Suit equipped with Scott Suit Controller, Scott Vent Inlet Disconnect Assembly and Scott Suit Inlet Check Valve.

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Department of Civil Aviation, VH-CAV, had displayed erroneous readings of the instruments operated by its port static system, and that at the conclusion of each of two flights a small quantity of water had been drained from that system. Further reference will be made to these and other incidents of a similar kind at a later stage of this report.

Ground Rig

This incident led to initiation of experiments both on an operating aircraft and a ground rig for the purpose of determining what effect (if any) given quantities of water in the static systems could have on the operation of the instruments. The results of these experiments were demonstrated on the ground rig before the Board.

The experiments so conducted justify, I think, the following conclusions:

- **That water in the system** on the starboard side would not produce errors in the altimeter on that side. The automatic pilot unit is connected under the floor of the cockpit to the static system of that side of the aircraft. Even if water in significant quantities collected in that area of the line it would, in the main, pass into the automatic pilot unit and not proceed to the instruments. Normally the first officer, not the captain, would be operating the aircraft on the starboard side. If, therefore, the first officer were operating the aircraft at the time of the accident the result of the experiments leads to the conclusion that his instruments would not have been affected by any water in the system and he would not have been misled by them.
- **The same conclusion** cannot be reached as readily in relation to the system on the port side.

It is clear that the mere presence of water in the static line in the wing, where the bends were present, would not have any critical effect on the instruments. In the circumstances of the fatal flight it could only have had such an effect if, in the course of the final descent, water present there had moved along the line and "toppled over" at Station 3100 into the cockpit area.

The justification for this view is that had water been present earlier in the line under the cockpit floor it would have manifested its effects during the abortive attempt to land when the aircraft descended from 13,000 feet to 50 ft.

All the evidence supports the view that the pilot at that stage had the aircraft completely under control and that his instruments were operating normally.

Even if the presence of water in the wing lines be assumed, the experiments conducted on the rig indicated that it was unlikely to move to Station 3100 and topple over during the final descent from 5,000 ft.

However, it is not possible to reproduce on the rig the precise circumstances encountered in the holding flight which lasted for about 1 hr. During that period the aircraft was changing direction frequently and it is possible that the slopes so created might have moved water so that globules collected in the form of a slug which toppled over at Station 3100 during the descent.

The experiments indicate that with 7 cc. of water acting in this way in the rig it

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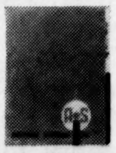

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would pass over the fuselage drain under the floor of the cockpit and proceed along the static line towards the instruments. In so doing it would interfere with the transmission of air pressure to the instruments, and the altimeter would cease to measure the correct altitude. In fact in this situation, with the aircraft descending, the altimeter would indicate a descent but the descent so registered would be less than actual. The experiment showed that, as far as the test rig was concerned, if the water toppled at a simulated height of between 3,000 ft. and 2,000 ft. in a descent it could cause the altimeter to read about 1,000 ft. at the time when the descent itself had reached sea level.

It is necessary to emphasize some other effects which the presence of water in sufficient quantities at the critical point would have had. The experiments indicate that the vertical speed indicator would register a lower rate of descent than the actual rate, the airspeed indicator would show a steadily increasing air speed which toward the end of the descent would read some 50 kt. higher than it should, and the attitude of the artificial horizon would show a much steeper descent than that indicated by the vertical speed indicator.

Another element not to be discarded is the likelihood that in a familiar operation of this kind the captain might sense that his descent was steeper than the altimeter indicated.

Incidents involving erroneous indications in altimeters on three Fokker aircraft VH-CAV, VH-TFD, VH-TFG, were related to the Board. In each case it seems clear that the incidents were not attributable to the presence of water in the critical section of the static line as after the incidents no water was found in that section. The explanation of the incidents appears to be that there was some temporary obstruction of the static system in the outer wing area due to the formation of ice. The temperature readings during the period in which the ill-fated aircraft VH-TFB was holding over Mackay negative any suggestion that the static system in that aircraft was at the time affected by the formation of ice in the static lines.

Conclusions

The conclusions reached on this aspect of the matter by the investigating team were as follows:

- “**The rig test** did not necessarily reproduce exactly what would happen in an aircraft but gives the order of the effects.
- **Current operational procedures** have made air crews aware of the possibility of water contamination of instrument systems and if observed will prevent hazardous situations.
- **The incidents** to both VH-CAV and VH-TFD were most likely caused by an ice blockage in the outboard part of the system.
- **Water in the first officer's** static system could not have produced sufficiently large errors to cause the accident.
- **For water in the captain's** static to have caused the accident it must have toppled during the last descent at a height of between approximately 2,200 ft. and approximately 3,000 ft. depending on the quantity of water.
- **At least 7 cc.** of water would be necessary to cause sufficient error to account for the accident.

B-70 Throttle Motor

High-temperature motor for B-70, capable of operating over temperature range of —65F to 550F, will serve as primary throttle control system, replacing long-used mechanical linkage. Motor, developed by North American's Los Angeles Division, uses ceramic encapsulated wire and a stainless steel frame. Company says B-70 will be first aircraft to rely on electric throttle control system and eliminate linkage, to avoid problems of structural deflection and varying temperatures encountered during flight.

- **In being unaware** that there was an error in the static system the captain would have to ignore the readings of the airspeed indicator, the artificial horizon and his own sensory ability.
- **The first officer** would have to have been engaged for about 1 to 1½ min. in an activity which prevented his noticing the readings on his instruments.
- **Water could possibly** have collected into a slug in the wings during the holding flight at 5,000 ft. but is unlikely to have done so in the fore and aft lines aft of Station 3100.
- **Water in the wing lines** would be most likely to accumulate during the holding at 5,000 ft. at the point where the lines turn fore and aft in the fuselage and would be unlikely to reach Station 3100 in the necessary 2,700 ft. from commencement of the descent.”

These conclusions were in substance confirmed in a report submitted to the Board by Mr. Johannes Cornelis of the Fokker Aircraft Co.

In relation to F-27s, he said that the experience of those aircraft to date amounted to 70,000 flying hours, and although water has been found in the pitot static systems of such aircraft, as in other aircraft, it has never yet been found in a critical position in the system. The final view of the Fokker Aircraft Company as expressed in the report of Mr. Cornelis is as follows:

“For water in the static lines to have caused or contributed to the accident each and every of the following events must be assumed to have taken place:

- **That the captain** was flying the aircraft at the moment of impact. . . .
- **That there was enough water** to cause an eventual 1,000 ft. error present in the horizontal lines behind Station 3100 prior to the accident, the greater part of which must have been present in that location during all or most of the 34 flights prior to the last flight and that such water was all the time in such a form as not to show up by instrument fluctuations or instrument error.
- **That this water did collect** at a position in the lines where it would be just poised to topple over and did not collect at such a position during any of the 36 preceding descents and that this water toppled over on the last descent—a fact that has not happened to the best of our knowledge during any of the 70,000 flying hours performed to date by Fokker F-27s.
- **That the captain** did not observe any fluctuations in the instruments during the period in which the water toppled over and prior to its reaching the critical bend, which period would take about 1,000 ft. descent.
- **That the captain ignored** the airspeed indicator, rate of climb indicator, artificial horizon and his own sensory ability.
- **That the first officer** did not monitor the captain's instruments.
- **That, in case the captain** took over just about 1 to 1½ min. before impact and decided to ‘wipe off’ a small amount of apparent excess altitude, he did not perceive the delay or lag in his instrument indications within the period of 10 or 12 sec. in which he would normally have expected to ‘wipe off’ the excess height.”

In these circumstances it has certainly not been established to my satisfaction that the presence of water in the static line caused or contributed to the accident.

The possibility of water having accumulated over a period in the bends in the system, to which reference has already been made, cannot, however, be excluded. It is unlikely that such water, if present in the course of the final descent of the aircraft, found its way to the critical part of the system on the port side. If it did it has been shown that it could result in a misrepresentation of the altitude of the aircraft in the course of that descent. It is not unlikely that the captain was piloting the aircraft at this stage. Having regard to the presence of fog in the area, and the earlier abortive attempt to land, both he and the first officer might have directed some of their attention to its possible presence. In these circumstances, while it is unlikely, it doesn't seem impossible that they might not become aware of any abnormal behavior of the instruments at the crucial time until it was too late.

In the search for an explanation of an accident which is well nigh inexplicable, I am unable to make a positive finding that water in the static system did not cause or contribute to the accident. It must, at least in my view, be regarded as a possible though not probable cause.

The remaining possibility which requires consideration is error of the pilot.

It is not possible on the evidence to determine whether Capt. Pollard or First Officer Davis was flying the aircraft at the relevant time.

It is clear that Davis was to undergo a proficiency check on this flight, and it may fairly be assumed that for some part of the flight, at least, he was at the controls. Pollard, when the aircraft left Rockhampton, was occupying the port side or captain's seat. That he continued to do so is confirmed by the fact that the starboard seat belt was around the body of First Officer Davis when it was recovered. The conversations with the air controller at Mackay probably were conducted by Pollard, and the substance of those which preceded the abortive attempt to land suggest that he flew the aircraft at that time.

However this may be, there is no evidence as to which of them engaged in the final descent other than the fact that the injuries received by Capt. Pollard are consistent with the captain's seat being in the forward position at the moment of impact. From this alone it is not possible to reach any firm conclusion, although on the whole I think it is probable that Capt. Pollard flew the aircraft in the final descent.

He was a highly competent pilot with a long flying experience. There is evidence in relation to this flight that in two minor respects he acted in a manner not consistent with regulations. They were both matters as to which I would conclude that he was satisfied on sound grounds that no element of risk was involved. I am not prepared from these instances to draw any inference that he might disregard regulations in any manner or degree if the safety of his aircraft or passengers was involved.

Altimeter Error

The kind of error in the reading of the altimeter, which in the final stages would account for the accident, is one in which a measurement in hundreds is mistaken for a height of over 1,000 ft. and an ultimate misconception that a measurement of 100 ft. was 1,100 ft. It seems unlikely that a pilot of such experience as Capt. Pollard would so misread his altimeter as to mistake a reading of 100 ft. for 1,100 ft. While this may be possible for the uninitiated, it is difficult to attribute such an error to an experienced pilot, more particularly as such a misreading could only occur after he had descended to 100 ft. without he or the first officer being aware that the aircraft was descending much too low. It would seem that this could only occur if the attention of both of them were diverted from the instruments at the same time either by concern for the possible presence of fog or some other circumstance of which there is no evidence.

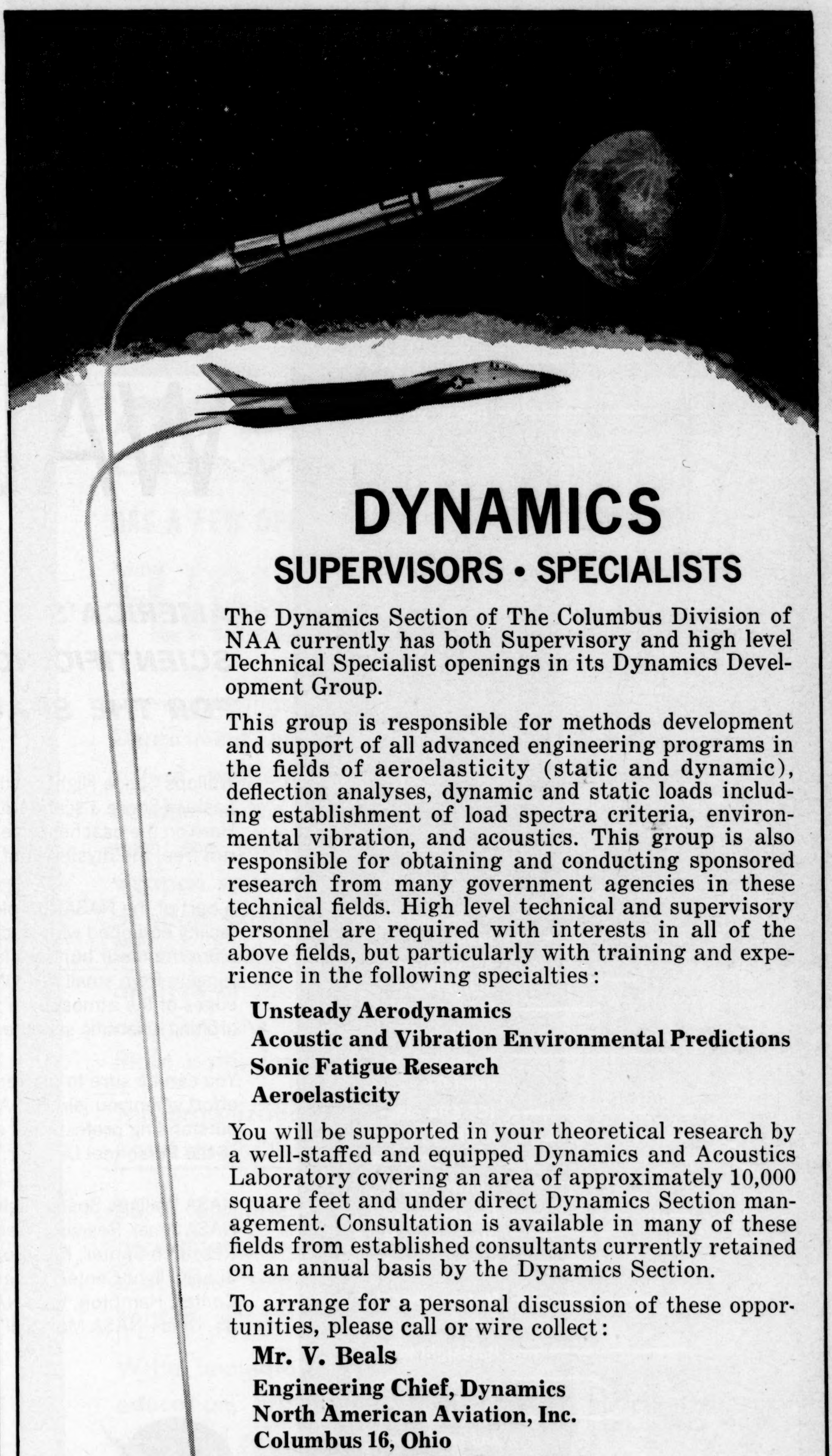
Similar considerations weigh against the possibility of the first officer getting so low without at least the captain observing on his instruments the excessive descent. If the aircraft followed a course similar to that which has been plotted as its assumed course, it was in the final stages of the descent in an area where there were no clearly visible landmarks for guidance, and it is scarcely rational to assume that the pilot would disregard the safety provided by his instruments for his own inadequate visual observation.

For these reasons I am not satisfied that the accident was due to an error of the pilot in reading the altimeter or to a complete or partial disregarding by him of the information his instruments provided.

The most that can be said is that some error of the pilot in flying the aircraft has not on the evidence been excluded as a possible cause of the accident.

I summarize my conclusions as to the accident and the cause of the accident as follows:

- **On June 10, 1960,** at 10:05 p. m. Fokker Friendship aircraft VH-TFB, owned by the Australian National Airlines Commission and operated as part of Trans-Australia



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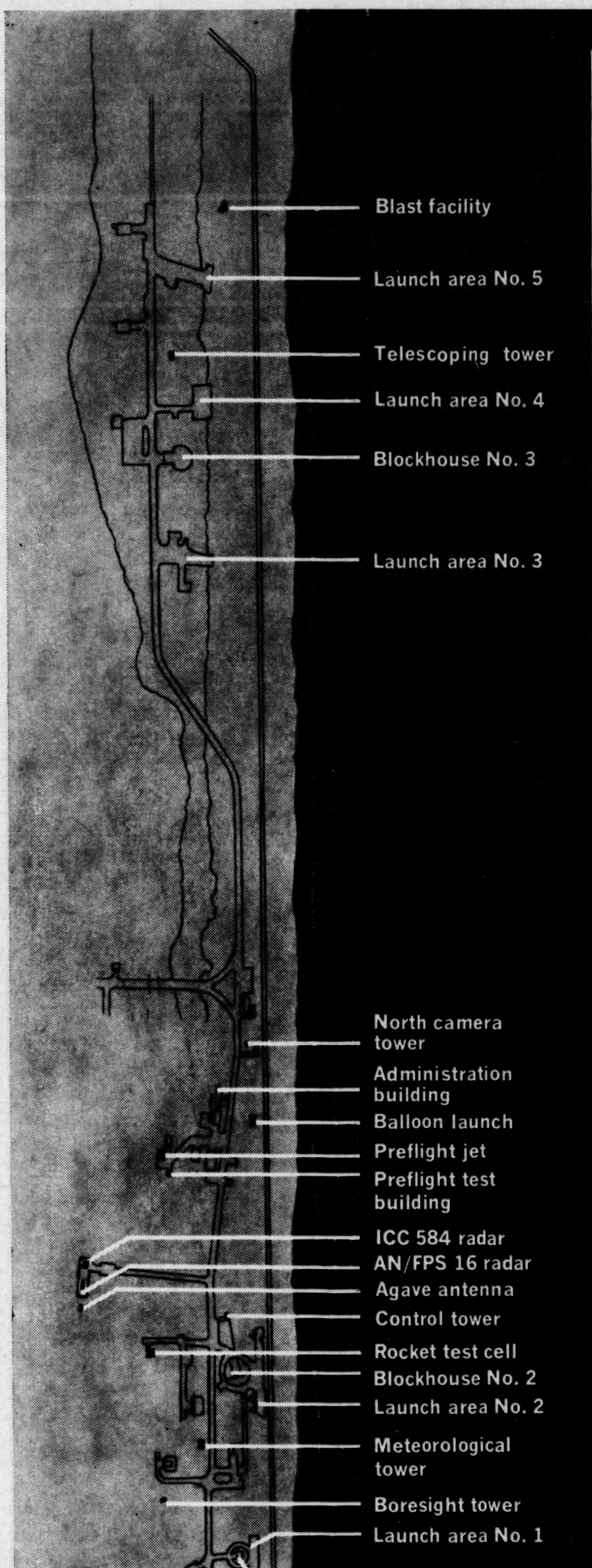
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- **At the time of the accident** the aircraft was approaching the Mackay Airport with a view to landing.
- **A clearance** to make a visual approach was properly given by the air controller at Mackay.
- **The weather conditions** at the time presented no hazard to a safe approach and landing, and all the radio navigational aids and airport lighting facilities were functioning satisfactorily at all relevant times.
- **The pilot** and the first officer were properly licensed, trained and competent officers.
- **They were both in good health** and there is nothing to suggest they did not have complete control of the aircraft or were at any stage rendered incapable of fully performing their functions in relation to the flight.
- **Until at least 10 p. m.** conditions on the aircraft were perfectly normal.
- **There is no evidence** to suggest that between 10 and 10:05 p. m. this condition of normality did not continue.
- **The aircraft entered** the water with its engines under power at a speed of not less than 160 knots.
- **The evidence does not support** any conclusion other than that the aircraft and its engines were functioning normally.
- **The aircraft probably struck** the sea in a flat attitude between 5 deg. nose up and 5 deg. nose down and banked to starboard at an angle of between 5 and 10 deg.
- **The aircraft descended** towards the sea at not less than 900 fpm.
- **The evidence supports** the view that the electrical equipment of the aircraft was functioning normally at the time of the impact.
- **There is no evidence** of fire or explosion having occurred at any time prior to or subsequent to the impact.
- **The circumstances** of the accident suggest that for some undiscovered reason the aircraft was being flown at a lower altitude than the pilot intended.
- **The evidence does not support** a conclusion that the instruments or any of them were not functioning properly.
- **It has not been established** by the evidence that there was at the relevant time any water in the pitot static system of the aircraft, and the evidence does not justify a conclusion that water in the static system caused or contributed to the malfunctioning of the instruments.
- **The possibility** of the existence of water in the static system so moving along the system as to cause a malfunctioning of the instruments cannot, on the evidence, be entirely excluded as a possible cause of the accident but the evidence points to the fact that such a happening was improbable.
- **The evidence does not justify** a finding that the captain or the first officer, or both, misread the altimeter or that the altimeter misrepresented the actual height of the aircraft.
- **The evidence does** not justify any finding that the captain or the first officer in flying the aircraft disregarded or paid insufficient attention to the instruments and relied

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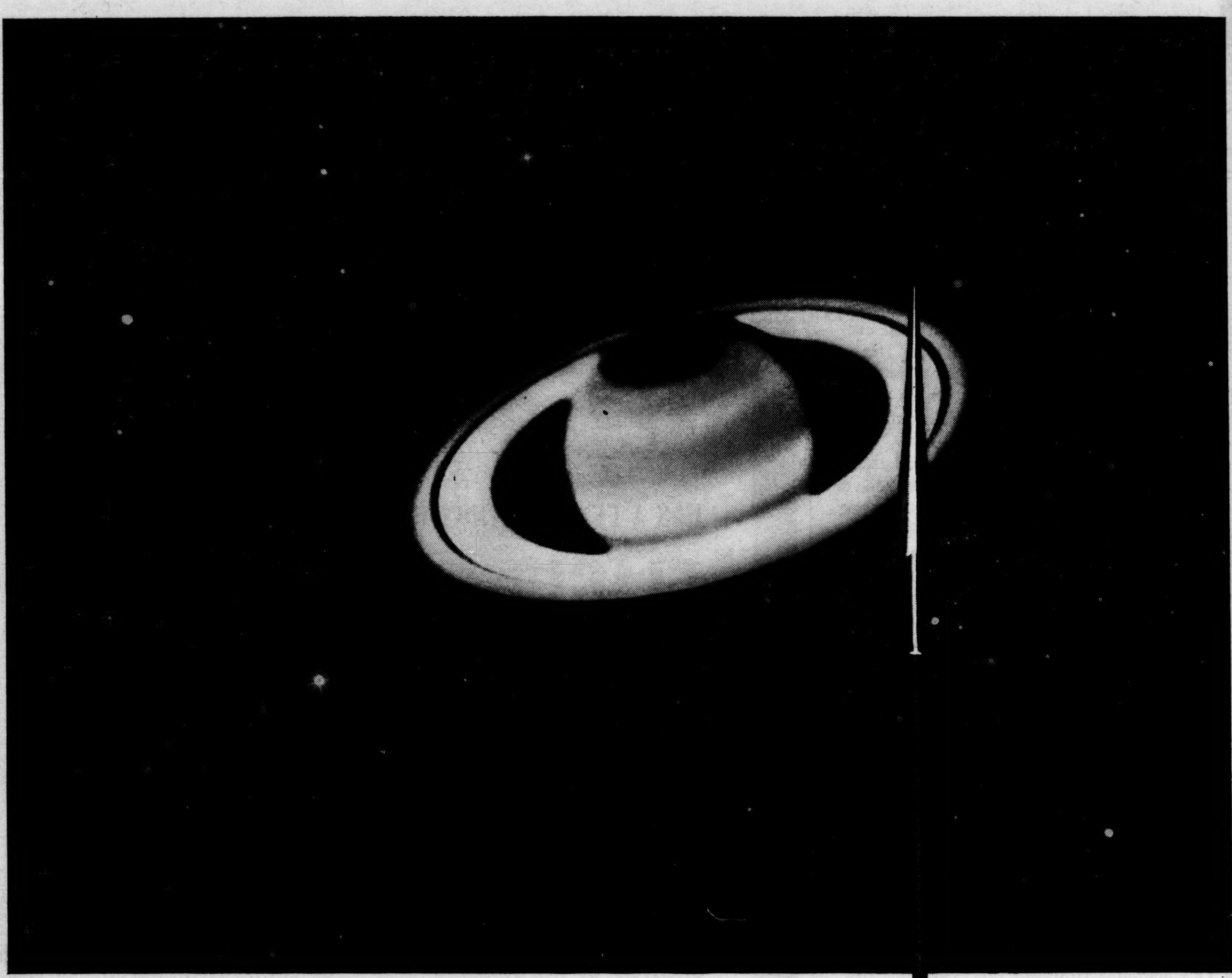

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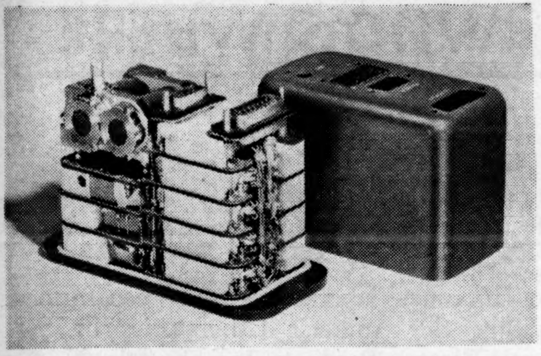

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unduly upon visual observation by which he was misled.

- **In the absence** of any other explanation of the accident the possibility that undue reliance upon visual observation by the person flying the aircraft at the relevant time must remain a possibility.
- **The evidence** does not support a conclusion that any sudden emergency caused the accident, but such a possibility has not been entirely excluded.
- **The aircraft struck** the sea at a time when its altitude should have been not less than 1,000 ft., but it is impossible to say how this occurred.

It has proved to be impossible to reach any firm conclusion as to the cause of the accident because, there being no survivors of the fatality, there are no means of ascertaining what occurred on the aircraft in the last few minutes of its flight.

It would, no doubt, have been enlightening to have a record of any conversation which took place between the captain and the first officer during that period and of the readings of the flight instruments up to the moment of impact.

Counsel for the Department of Civil Aviation informed the Board that the Department has since 1955 been engaged in work on instruments known as flight recorders which would be capable of providing such information in the case of an accident such as this. I am advised that considerable development has taken place both here and abroad in relation to such instruments, but we were informed that the Department had not yet had presented to it an instrument which is sufficiently perfected to justify the installation of such instruments in aircraft in Australia.

The interest which the Department has displayed in this matter is commendable. It is recommended that the search for such an instrument should be pursued in the hope that satisfactory flight recorders can be installed at no distant date.

There would be a legitimate objection to the installation of such instruments if the recorded material were available to operators at the conclusion of every flight. I am advised however that instruments are in the process of development which will automatically obliterate earlier recordings as the flight proceeds so that only the events of an immediately preceding short period will at any time be preserved and that the whole recording will be obliterated immediately upon the pilot stopping the engines at the conclusion of each flight. The installation of such an instrument is not therefore necessarily subject to the type of objection to which I have alluded.

The possibility that some misreading of the altimeter contributed to the fatality has already been discussed. There can be no doubt that misreading of altimeters has heretofore been the cause of some accidents. It is not easy to devise an instrument of this character which will be proof against the possibility of any human error, and modifications of existing methods of presentation, while avoiding one source of possible error, may but provide another.

Despite the difficulties which this problem presents it is urged that investigations into improved presentation of height information should be pursued.

Instruments at present in use provide information as to height above sea level. Radio altimeters are capable of providing information of the actual height of the aircraft above the terrain over which it is being flown. I am advised that no suitable equipment of this kind for installation in aircraft is at present available.

It is recommended that steps should be taken to develop an instrument suitable for the purpose and that it should be an instrument employing a single pointer.

It is recommended that consideration be given to revising the visual descent procedures employed at night at Mackay having regard to the large sectors where there are no visual cues such as ocean area.

It is suggested that, when meteorological conditions permit, aircraft approaching the airfield at night should not descend below 1,500 ft. until within seven miles of the airport as measured by DME. This height is in conformity with the lowest altitude to which aircraft may descend at Mackay during an instrument approach before commencing final descent.

It may be that such provisions would be appropriate at other airports at which similar conditions prevail.

In addition to these recommendations it is appropriate to report that the Fokker Co. proposes to make certain modifications in the pitot static system. These are designed to eliminate any possible risk that any small quantities of water which may enter the system will affect the operation of the instruments by movement along the lines towards the instruments. The Board was informed that work in this direction was going on with a view to making the drainage valves more effective by ensuring that any water passing to them is trapped and retained. Such modifications may have application in other types of aircraft.

Further precautions being taken with the present system which are significant are more frequent blowing of the lines to remove any water and an inspection of all Fokker aircraft with a view to eliminating any such irregular bends in the system as were found in F-27 VH-TFB.

J. A. Spicer, Chairman
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Electronics Engineers who are qualified, through education and experience, and who are seeking better opportunities to technically express themselves in any of the aforementioned fields, please forward resume to:

Mr. H. Keever
Engineering Personnel Supervisor, Box AW-234
North American Aviation, Inc.
4300 East Fifth Avenue
Columbus 16, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.

WHO'S WHERE

(*Continued from page 19*)

Changes

Walter D. Smith, chief engineer, the Martin Co.'s Cocoa (Fla.) Division at Cape Canaveral.

Three new laboratories have been formed within the Amherst Laboratories of Sylvania Electric Products, Inc., Buffalo, N. Y., and the following have been appointed as managers: **Dr. Robert L. San Soucie**-Advanced Communication Systems Laboratory; **Dana W. Cole**-Product Development Laboratory; **Albert W. Puttick**-Product Engineering Laboratory.

R. R. Reagan, assistant manager-Travel Air and Baron sales, Beech Aircraft Corp., Wichita, Kan.

Harvey J. Finison, director-business planning and development, Electronic Components and Devices Group, Raytheon Co., Waltham, Mass. **E. Nevin Kather** succeeds Mr. Finison as general manager of the Semiconductor Division; **Edward L. Dashefsky** succeeds Mr. Kather as general manager-Microwave and Power Tube Div.

James B. Connelly, director of field engineering, Sperry Gyroscope Co., Great Neck, N. Y., division of Sperry Rand Corp.

Vincent A. Melfi, manager, Undersea Warfare & Guidance Seeker Products-Manufacturing Section, General Electric Co.'s Light Military Electronics Department, Utica, N. Y.

Wayne D. Stinnett, manager of the newly formed Special Projects Division of Aerojet-General Corp.'s Liquid Rocket Plant, Azusa, Calif.

Dr. Gaelen L. Felt, manager-Las Vegas (Nev.) operations of Edgerton, Germeshausen & Grier, Inc., Boston, Mass.

Clarence S. Jones, chief engineer of the Western Laboratory, Palo Alto, Calif., of Link Division of General Precision, Inc.

Dr. Harold R. Luxenberg, reconnaissance systems head, Westwood Division of Houston Fearless Corp., Los Angeles, Calif.

Wayne E. Harness, general manager, Instrumentation Division, Quantatron, Inc., Santa Monica, Calif.

Edgar M. Shurtleff, director of research and development, Special Devices, Inc., Pacoima, Calif.

Elias Weinberger, manager, Communications and Data Processing Laboratory, Military Products Division, Hoffman Electronics Corp., Los Angeles, Calif.

Dr. T. J. Bulat, manager-sonic engineering, Pioneer-Central Division of the Bendix Corp., Davenport, Iowa.

Boris Cohen, division manager, Anti-Submarine Warfare Division, Loral Electronics Corp., New York, N. Y., and **Santo Scibilia,** division manager, Passive Detection Division.

Douglas D. Ordahl, manager, Propellant Development Branch, United Technology Corp., Sunnyvale, Calif., a subsidiary of United Aircraft Corp.

James L. Carnes, manager of advanced planning, Thiokol Chemical Corp.'s Rocket Operations Center, Ogden, Utah.

John J. Landers, manager of product sales-gyroscopes, Precision Products Department of Nortronics, a division of Northrop Corp., Norwood, Mass.

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LETTERS

Guidance Computers

Dr. Paul H. Savet is certainly justified in pointing out the achievement of inertially guiding the Atlas over ICBM ranges (AW Jan. 23, p. 118). I know how he feels, because we have been overlooked in several publications which tell the Polaris story.

However, my purpose in writing is only to set the record straight. The Instrumentation Laboratory of Massachusetts Institute of Technology has also designed "a fully transistorized digital computer with no moving parts" for a guidance system. The complete system was flown as a passenger in a Polaris missile on July 15, 1959. First fully-guided flight was Jan. 7, 1960. I claim these dates are significantly earlier than those established by the Atlas computer. Also I would welcome the opportunity to compare sizes and weights.

Ralph R. Ragan
Deputy Associate Director
Instrumentation Laboratory
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology
Cambridge, Mass.

Industry Cooperation

A new and thinking President, with the forward look, has brought the challenge of the Sixties to our attention. He has asked that not only a youthful and energetic government do all it can for the people, but firmly requested that we do for our government and ourselves. May I suggest the following as a change in pace in the progressive and ever-changing field of aviation?

Aviation has been my livelihood for the past 21 years. All these years have been spent in two of the least secure phases of the business—military aviation and the hectic existence of the fixed-base operator. There are perhaps as many theories about flying as there are instructors; perhaps as many ways to run an airline as there are airlines; as many ways to spray and dust crops as there are men in that phase of the industry; as many ideas on how to run an air taxi business as there are companies; and perhaps more regulations, outmoded and current, than we, the doers, can possibly comply with. But each person involved should have but one goal—to foster the growth and development of aviation. Through agonies and blunders on the part of government and industry, and despite these, aviation has firmly established itself as one of our greatest military assets and an indispensable commercial enterprise. It is our newest and most challenging of our frontiers of the Sixties. Our present status has been achieved with more than a little bit of love on the part of those dedicated in the field. Yet we have just begun.

Both in government and the industry, let us not forget the true meaning of public convenience and necessity. Let's not forget that the taxpayers' dollars have been largely responsible for our success. Let's have each facet and phase of the industry be aware that the other exists and that we can realize a bountiful future only through coordinated effort. We all need to increase our scope and view of the total picture in order to gain efficiency. It is equally important that the lawmakers and investigators have the same scoping view.

Aviation Week **welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.**

For a change, let us have an amiable relationship between governing bodies and the industry that fosters progress and penalizes none before a just verdict has been reached.

Let's have a Federal Aviation Agency and Civil Aeronautics Board with enough flexibility of thought to realize when a regulation has become harmful or outmoded, and with enough foresight to make the new law beneficial rather than a deterrent. Let the industry for once think collectively and unselfishly of the needs and problems of all.

Let us look to government as a benefactor and not a Gestapo unit.

I suggest that a thinking President, not unfamiliar with the problems of our industry, has lighted the green light for progress and action for every American. May I suggest that we all start working at this through the friendly, intelligent, and positive approach?

George E. Parmenter
President
Cape & Islands Flight Service, Inc.
Hyannis, Mass.

GEM Missions

Re: Military Studies Ground Effect Vehicle (AW Jan. 23, p. 71).

As a long-time subscriber to the finest aviation publication available, I would like to comment on Mr. Anderton's article on GEMs.

Once again, our industry is slowly following the lead of the British in a field that promises such great dividends if properly exploited. One excuse given for our number two position is a lack of general military and/or commercial application. Nothing could be further from the truth. For the benefit of those seeking practical and profitable uses for these vehicles, I submit the following areas which are in dire need of this type machine. Engineering studies have already indicated the feasibility of these proposed applications.

- **Military.**

The greatest military threat to the free nations of the world today is the large fleet of Russian submarines because they have a much greater potential than the Germans had at the start of World War II. The Germans succeeded in destroying more than 1,500 allied ships in the first 12 months of the war. Can we expect our losses to be less in a future conflict? Added to this threat is the missile sub. Let us eliminate this first problem by converting our surface ships to GEMs. Studies indicate the feasibility of a two-million-pound vehicle with a two-million-pound payload. This vehicle can carry this load for an indefinite range at a cost of three to five cents per ton mile. It would cruise at 100 kt. at an altitude of 12 ft. This would present a tough target for any submarine because he would have to surface to detect or attack it. If the sub did surface, it would then be a most vulnerable target itself.

Studies further indicate that the larger the vehicle the more efficient it becomes. In addition to the aforementioned benefits, this type craft needs no port facilities. Only a cleared path is required, the type provided by Mr. Le Tourneau's earth clearing machines. This in turn makes dispersion of industry a paying proposition and the better strategic targets begin to disappear. This is but one needed application of the GEM principle. The biggest benefit of all from this system is the freeing of our ASW forces to concentrate on the hunter/killer efforts so vital to any effective solution of the missile submarine threat.

- **Commercial.**

The underdeveloped nations of the world are fighting for their very survival. If they are to remain free and independent, they will have to develop their economies at a much faster rate than now appears possible. We are all aware that a prerequisite to any sound commercial venture is adequate communications. If these nations are to develop, they must first have effective communications. To develop conventional systems in the time available appears impossible.

The GEM concept, however, not only makes it possible, but profitable to those concerned. The concept is a proven one. With earth clearing equipment, paths can be cut through jungles. Rivers and lakes are natural pathways. The world is crying for these machines. American factories are today idle but ready to produce these machines. American salesmanship and coordination can bring these needed machines to our less fortunate neighbors and, in the process, expand our industries. Only by providing the needed services can we expect to expand our markets. Unless we fill this need the Russians will, because they are already hard at work developing this concept.

In summary, it appears that we are so willing these days to ignore the efforts of American inventiveness and to sit back and wait until our competitors have the jump. Today we possess the know-how, the resources and the need to expand this concept. Let's stop looking for applications and start filling the ones that are so critically needed today.

Lt. R. L. Helms, USNR
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Training Squadron ONE
U.S. N.A.A.S. Saufley Field
Pensacola, Fla.